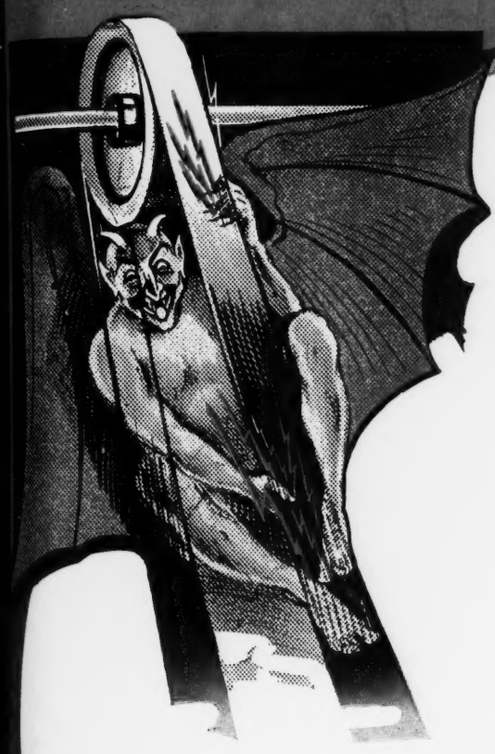
Volume 30 AUGUST, 1924 Number 12

AUG 1 1924

MACHINERY

THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YORK



They are easily installed right in your present hangers

Stop Thief—

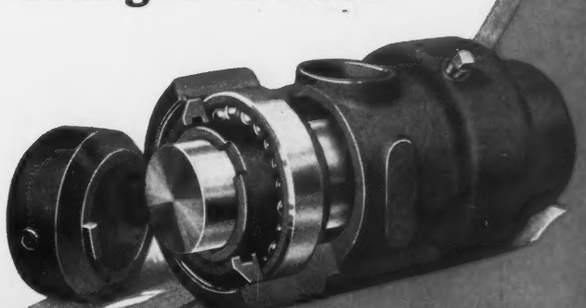
Is there a thief in your plant; a thief that works every minute the factory is in operation; a thief that has no physical dimensions, occupies no space, cannot be seen, and is, therefore, apt to escape notice?

This thief is day in and day out causing heavy losses in hundreds of plants. The name of this rascally intruder is Friction.

If your line shafting is carried by plain bearings, this scoundrel, Friction, is flourishing right over your nose, and you are paying for the power that nourishes him, but which is a dead loss to you.

You can stop this thief; you can banish Friction from your plant by replacing your present bearings with

Fafnir Double Ball Bearing Hanger Boxes



The Fafnir Bearing Company
NEW BRITAIN, CONN.

FAFNIR

A Complete Range of Sizes ¼" to 1½"

"Bristo" Safety Set Screws are usually used in lengths equal to diameters, although we carry screws up to 4" long.

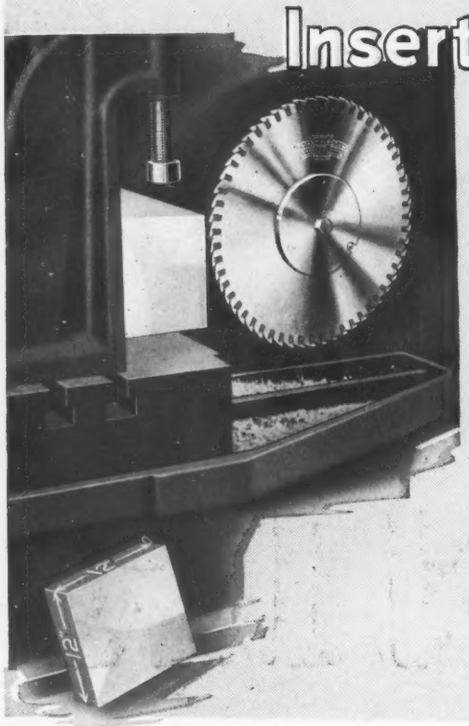
The shorter lengths are more economical, and also have the advantage that by using a couple of short screws instead of one long one in a deep hole, the second screw clamps the first one in place.

Remember the twofold value of "Bristo" dovetailed flutes—giving the wrench a better grip and assuring a tight fit by expansion after the last tightening turn.

May we send Bulletin 811-E and samples, free?

THE BRISTOL COMPANY
WATERBURY CONN.

SIMONDS
Inserted Tooth Metal Saw



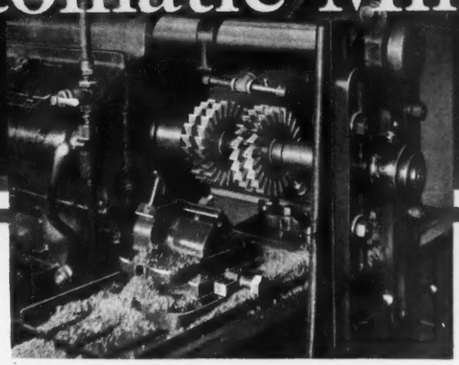
For accurate and rapid metal cutting the **Simonds** Inserted Tooth Saw is the most successful metal saw on the market. Its teeth of extra fine High Speed Steel, fitted to a strong, and scientifically perfect plate, withstand wear and give the maximum service.

Write for catalog and prices.

Simonds Saw and Steel Co.

Fitchburg, Mass. Chicago, Ill.
5 Factories Established 1832

Automatic Milling



The Brown & Sharpe Method as Applied to Various Operations Selected to Show How Different Classes of Work are Milled on Automatically Controlled Machines

By FRANKLIN D. JONES

IN determining what equipment and methods to employ for milling duplicate parts, there are three points that a competent milling machine engineer considers very carefully. One pertains to the working or cutting period; the second has to do with the method of holding and presenting the work to the cutters; and the third relates to non-cutting time which may be necessary, it being generally conceded that "air cuts" are non-productive. The order in which these three points are given is not intended to indicate their relative importance, since this varies more or less for different operations.

In connection with the cutting period, the type of cutter and its support, the speed of rotation or cutting speed, and the rate of feed are the important factors. The method of holding involves both the design of the fixtures and their location relative to the work-table or cutters. The non-cutting time is represented by the passage of cutters from one part to another, and also by return movements, as when a machine of the reciprocating type is arranged to cut either in one direction only, or at both ends of the table. In using the type of machine employed for the operations to be described, all non-productive periods are largely eliminated by the use of rapid movements or "jumps" between cuts or across intervening spaces between parts or fixtures, the machines being arranged to control such accelerated movements automatically.

The examples that follow illustrate the importance of the different points mentioned, and show interesting variations in methods of milling different classes of work. The milling machines used are the Brown & Sharpe automatic types (Nos. 21 and 33) and before considering their application, a few of the more important operating features will be explained, so that the exact method of performing different milling operations will be entirely clear.

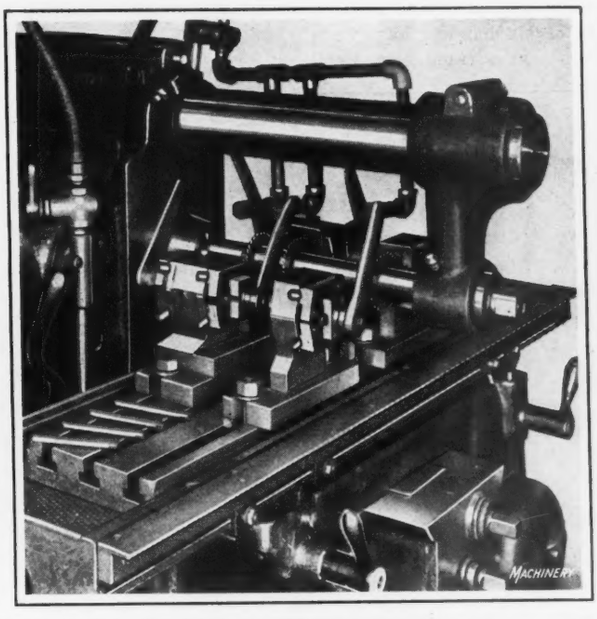


Fig. 1. Milling Slots in the Ends of Knife Handles, Six Handles being milled simultaneously

The operation of these milling machines is controlled automatically, although the loading and unloading of the work is done by hand. The automatic control includes both table and spindle. The table can be given a variable cutting feed in either direction, a reversal of movement at any point within the range of travel, and if it is desired, the movement can be stopped automatically at the end of the table travel or the return. The spindle can be started, stopped, or reversed automatically, and the direction of rotation changed from right-hand to left-hand. These automatically controlled changes for both table and spindle may be actuated by dogs attached to the edges of the table, adjusted for properly timing the various movements. The different operations of the table and spindle are made to occur as the dogs engage tripping plungers which are located on the saddle, the dogs being set in the required position with reference to the work-holding fixtures.

Whenever the table movement is reversed, the fast travel is engaged. This rapid travel is at a constant rate of 210 inches per minute, and it may be utilized for any distance from ⅞ inch up to the maximum table travel. The variable feed or fast travel may or may not occur intermittently in either or both directions. For intermittent operations, several pairs of dogs may be used, as for milling a number of pieces arranged in tandem on the work-table.

The positions of the spindle and table-control handles determine what movement will take place when a dog engages its respective tripping plunger. For instance, if the spindle "throw-out" handle is thrown to the left, on both machines, the spindle rotates continuously in

one direction, irrespective of table movements; however, if this handle is turned to the right, the spindle stops when the rapid travel is engaged, and starts again when the cutting feed is engaged. If the spindle reverse handle is set in the down position, the spindle stops when table reverses, and the spindle reversal occurs when the cutting feed is engaged; shifting this handle to the up position permits the spindle to rotate continuously in one direction independently of the direction of table travel.

If it is desired to have the table stop at one end of its travel, one of the "table stop handles" is turned downward; the table will then reverse at one end of its travel and stop at the other end. If the table is to stop at each end of its travel, both handles are turned downward; with both handles up the travel is continuous. These different movements subject to automatic control under normal operating conditions may also be controlled by hand, if desired. In setting up a machine, the desired rate of feed and spindle speed are obtained by means of change-gears. The various ways in which different movements and combinations of automatic control are utilized in connection with the milling of parts of various shapes and sizes will now be explained in connection with a variety of automatic milling operations selected from actual practice.

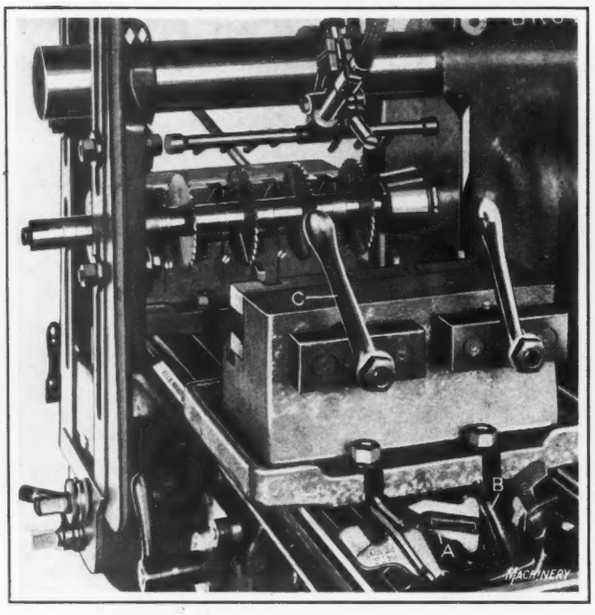


Fig. 2. Another Example of Multiple Slot Milling on an Automatic Machine

Multiple Slot Milling

The first example of automatic milling (see Fig. 1) is a simple one so far as the milling operation itself is concerned, but it is interesting because of the method of handling the work and the high rate of production attained. The operation is that of slotting the ends of malleable knife handle castings. Three slotting cutters are used, and these are located between two sets of fixtures, each of which holds six handles.

For work of this kind the cutters rotate continuously in one direction, and the reciprocating motion of the table is also continuous. After the ends of six handles have been slotted, the table movement reverses at a rapid rate, until the cutters are within about ⅛ inch of the six handles held in the opposite set of fixtures; then a table dog engages the cutting feed. At the completion of this cut, a second dog reverses the table at constant fast travel, bringing the work in the second fixture up to the cutters, when the cutting feed is again engaged. While the cutters are at work, the operator is reloading the idle fixtures.

Another example of plain slot milling is shown in Figs. 2 and 3. A gang of four high-speed steel slotting cutters is located between two fixtures, each holding four malleable unit-control brackets. The operation is that of milling a slot in a projecting part of the casting, the milled slot connecting with a cored slot extending through the body of the casting. An unmilled casting is shown at *A*, Fig. 2, and a milled casting at *B*.

The diagram, Fig. 3, illustrates the cycle of movements. In order to simplify this diagram, the cutters have been represented as moving from one fixture to the other, although it is evident that the actual movement is applied to the table and not to the spindle. The rapid travel locates the cutters within about ⅛ inch of the work, or in position *A;* a dog then actuates one of the plungers and the cutting feed is engaged. At the end of the cut, or at position *B*, another dog reverses the table, which returns at fast travel to position *C*, or to the point where the cut begins on the opposite fixture; then the slow feed is engaged again and the movements just referred to are repeated.

The slotting saws used are 5 inches in diameter, ⅛ inch wide, and are given a speed of 81 revolutions per minute. The feed is 2.23 inches per minute, or 0.028 inch per cutter revolution; length of cut ⅞ inch; cutting time, 24 seconds; and return time, 3 seconds. The number of cuts per hour is 133, and as four castings are milled simultaneously, the hourly production is 532 pieces.

In milling parts by this method, the cutting time must exceed the fixture loading time slightly, and this factor, in conjunction with the design of the fixture itself, is what determines the maximum number of parts that can be

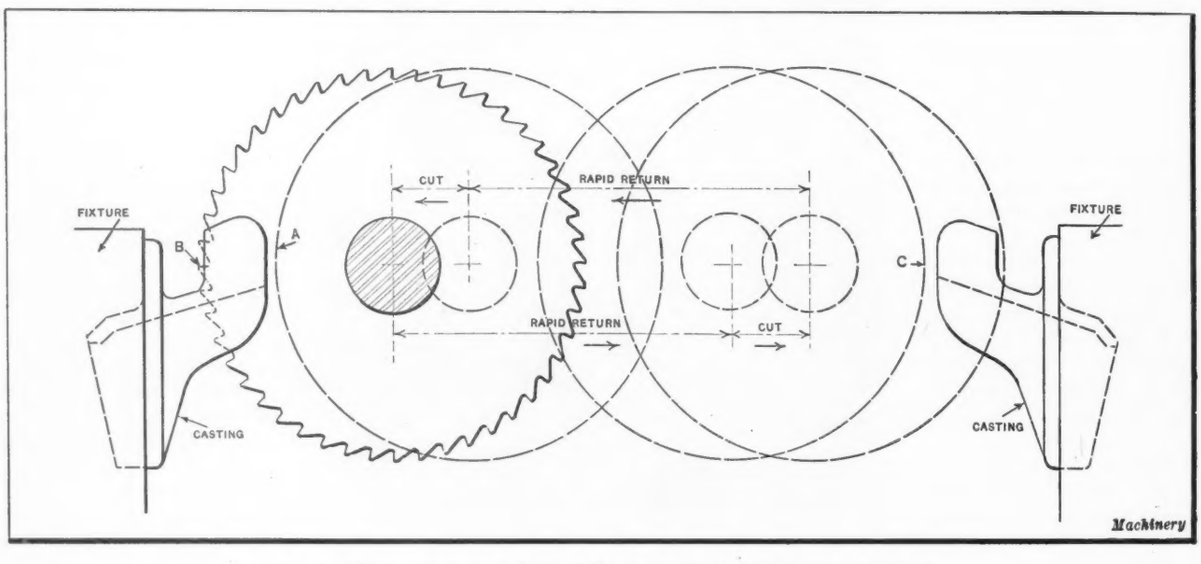


Fig. 3. Diagram illustrating Cycle of Movements for Operations shown in Fig. 2

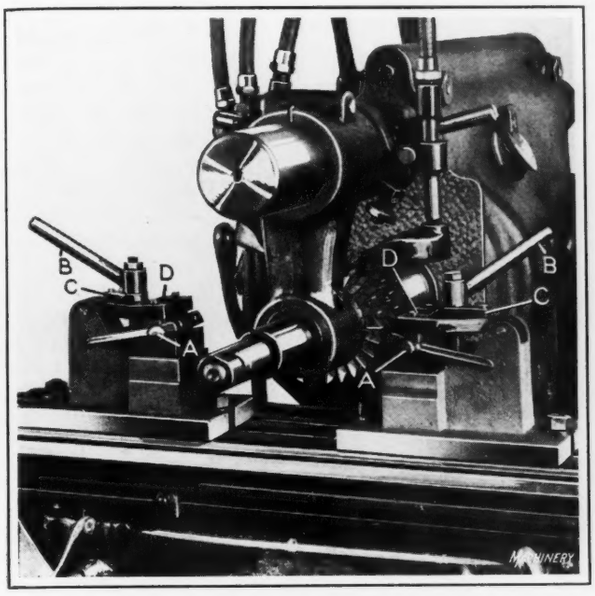


Fig. 4. Example of Straddle-milling on Automatic Machine

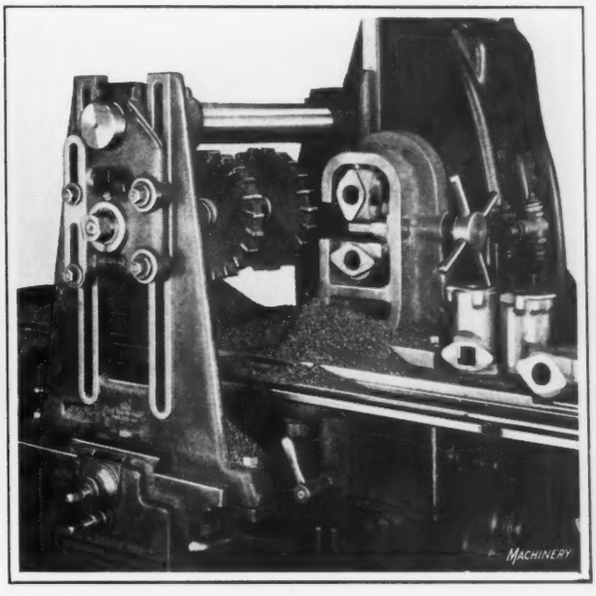


Fig. 5. Another Straddle-milling Operation

milled simultaneously. In some cases the rate of feed is reduced somewhat in order to lengthen the cutting time sufficiently to provide a long enough period for loading the fixtures. In other cases, where the loading time exceeds the cutting time, a higher production is obtained by operating the machine semi-automatically, as, for example, when both spindle and table movements discontinue temporarily at the completion of a cut.

Straddle-milling Operations

A typical example of straddle-milling by the automatic method is shown in Fig. 4. Two forged steel valve lifters are held in each of the two fixtures shown, and the two bosses *A* on each forging are milled by a gang of four cutters. The outer support for the arbor and arm has been removed to show more clearly the fixtures and work. Each forging is located by a pocket or recess formed in the fixture. The bosses to be milled are about the same height as the center line of the cutters, and the action of the machine is similar to that represented by the diagram Fig. 3; that is, the cutters rotate continuously in one direction, the reciprocating table movement is continuous, and the rapid travel up to the cutting point is followed by engagement of the cutting feed; then by the rapid return to the opposite fixture. This return movement for various automatic milling operations usually requires three seconds, and the distance between the fixtures is determined by the loading room.

To facilitate quick removal of the work, lever nut *B* acts against an open-side washer *C*, which is pivoted; hence, as soon as the washer is loose, and is turned far enough to clear the hub of the clamping lever, there is room to lift clamp *D* far enough to clear the work. The rate of feed for this operation is 4.6 inches per minute; length of cut, 1 inch; cutting time, 13 seconds; and return time, 3 seconds. The production is at the rate of 450 forgings per hour.

Fig. 5 illustrates a method of straddle-milling the ends of castings similar to those shown on the table of the machine. Two fixtures are used (although the one at the left of the cutters is not visible in the illustration), and two castings are held in each fixture. Again we have an example of continuous cutter rotation and table movement, but the cycle is varied somewhat and in a manner that illustrates the flexibility of the machine for meeting unusual requirements. As the milled faces of these castings must be flat within close limits, the first or roughing cut is taken across the face of the casting at the normal cutting feed. Then the table reverses, and at constant fast travel the cutters are brought in contact with the work on the return stroke. After the extreme edges of the castings have been cleared by the cutters, the cutting feed is engaged, while the central part of the casting is being milled. When this is finished, and the cutters approach the opposite edge, the fast travel is again engaged to complete the cut and bring the work in the opposite fixture up to the cutter where the same cycle of operations is repeated.

It was found that if the slow feed were used for the entire finishing cut, the extreme ends, where the area in contact with the cutters is small, would be slightly low; this was overcome, however, by accelerating the feed at these points, as described in the foregoing. The regular feeding movement is 11.28 inches per minute; the length of cut, 4¼ inches; and the rate of production per hour, 180 castings.

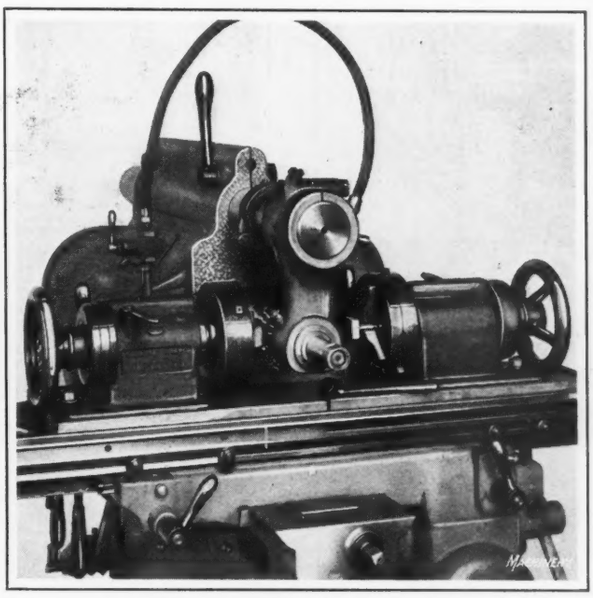


Fig. 6. Machining Bolt Heads by straddle-milling

The straddle-milling of bolt heads is shown in Fig. 6. In this illustration, the table has been moved toward the front in order to show the work more clearly. The two side mills used for this operation can be seen in back of the arbor support. After milling two sides of one bolt head, the rapid travel of the table locates the opposite bolt in the milling position, and while this cut is being taken, the first bolt is indexed one-quarter revolution. The single-dial index-centers

used are standard equipment. The rate of feed is 4.6 inches per minute; cutting time, 8½ seconds for each cut; total time for two cuts, 23 seconds; and production per hour, 156 bolts. The rapid return requires 3 seconds and is at a constant rate of 210 inches per minute.

For certain classes of work, the rotation of the spindle is reversed and two sets of cutters are used, one set being right-hand and the other left-hand. One reason for employing this method for certain operations is to have the feeding movements opposite to or against the cutter rotation, while the table is feeding to the right as well as to the left. Another reason for reversing the rotation is to have the thrust of the cut downward while milling parts held in both the right-hand and left-hand fixtures.

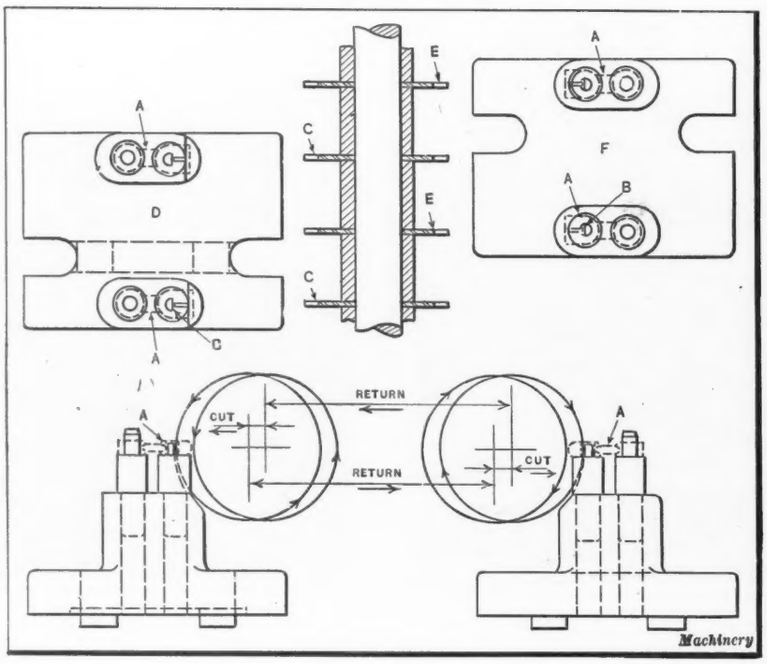


Fig. 7. Diagram of Milling Operation requiring Reversal of Cutter-spindle

The diagram Fig. 7 shows an operation requiring reversal of the cutter-spindle to obtain a downward cutting thrust for each fixture. The operation is simply one of milling slots in the ends of choke control carburetor levers. Two of these levers are slotted at each milling cut. The parts *A* are held without clamping by dropping them over two pins which pass through previously finished holes. The pins on the milling side are flattened, as at *B*, to provide clearance for the slotting saws. Two of the saws *C* are right-hand, and they slot the parts held in fixture *D*. The remaining saws *E* are left-hand, rotating in the opposite direction for slotting parts held in fixture *F*.

The complete cycle of movements is shown at the lower part of the diagram. It will be noted that the reversal of the cutter-spindle makes it necessary to use double the number of cutters that would be required for non-reversing operation, and also that the fixtures are staggered to align each one with its respective set of cutters. The saws used are 3 inches in diameter, 1/16 inch wide, and rotate at 155 revolutions per minute. The feed is 2.82 inches per minute; length of cut, ½ inch; cutting time, 11 seconds; return time, 3 seconds; and rate of production, 514 pieces per hour.

The milling of slots in the hubs of transmission shifter yokes is illustrated in Fig. 8. In this case the cutter-spindle is reversed in order to have the feeding movement against the cutter rotation at each of the two milling positions. Interlocking side mills having staggered teeth are used, and the two fixtures are offset to suit the location of the cutters as in the previous example. The rate of feed for these steel yokes is 5.47 inches per minute; length of cut, 1⅞ inches; and hourly production, 150 pieces.

Cutter-spindle Held Stationary During Return Stroke

For some operations, the rotation of the cutter-spindle is discontinued during the return stroke. Fig. 9 illustrates an operation requiring stationary cutters during the return stroke. The parts to be milled are steam turbine buckets made of monel metal. Concave grooves are milled across one side, and there are two rows of five buckets held by each fixture. The two right-hand cutters at *A* are at work while the table is feeding toward the left; at the end of this cut the spindle stops automatically, and the rapid travel is engaged. When fixture *C* reaches the cutting position, the spindle rotation is reversed. The left-hand cutters *B* then operate as the table feeds toward the right. As the return

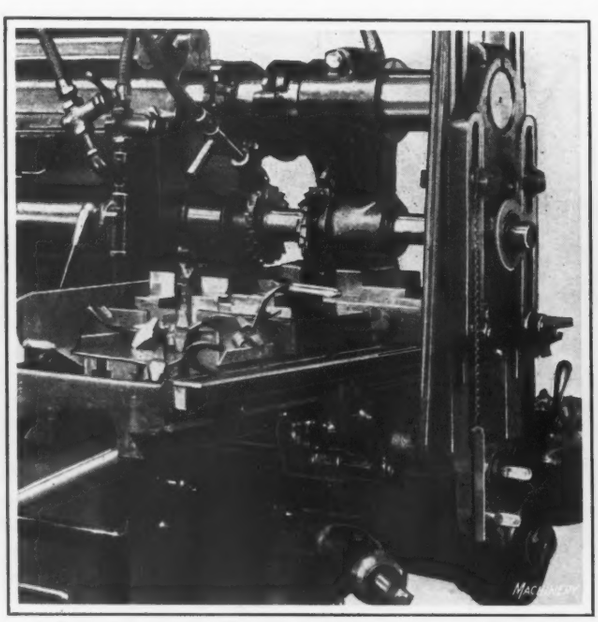


Fig. 8. Another Operation requiring Right- and Left-hand Cutters and Spindle Reversal

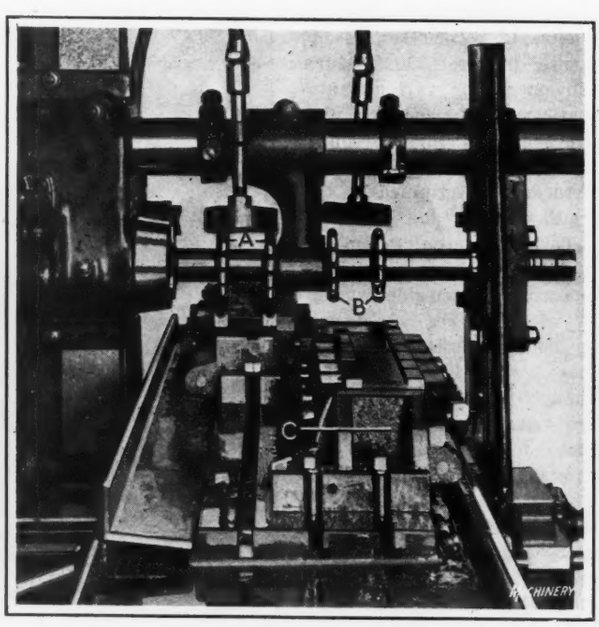


Fig. 9. Form-milling Operation on Steam Turbine Buckets, using Right- and Left-hand Cutters

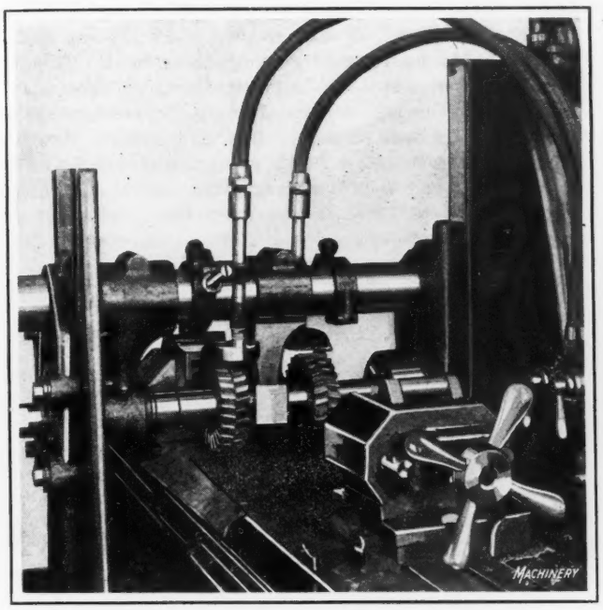


Fig. 10. Milling the Inner Faces of Lugs on Flange Yokes

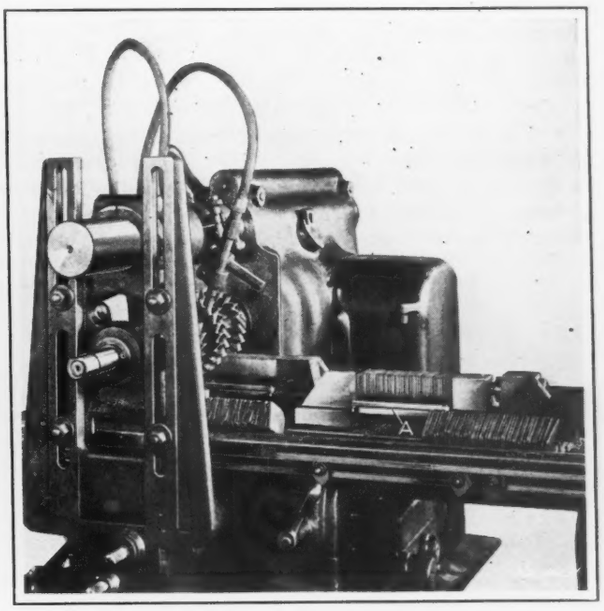


Fig. 11. Straddle-milling Stacks of Tool-steel Clipper Blades

movement occurs while the cutters are stationary, they do not score the work. These cutters are 4½ inches in diameter, rotate at 82 revolutions per minute, and are made of high-speed steel. The feed is 2.08 inches per minute; the cutting time is 377 seconds; and the return period is 6 seconds.

The automatic machine shown in Fig. 10 is arranged for milling the inner faces of two lugs which project from the sides of flange yokes. This operation is used for the purpose of illustrating the method adopted when the cut is heavy and it is necessary to have the thrust of the cut downward. The inner faces of the lugs are 2 inches apart, and half side mills are used. These half side mills have side teeth on one side only, and the teeth instead of being radial have front rake and are also inclined relative to the cutter axis, which gives a better cutting action. The two half side mills forming one cutter are so located relative to each other that the teeth are staggered to further improve the cutting action. The spindle stops at the end of the feeding movement and starts again with a reverse rotation just before beginning the cut on the other fixture. The feed per minute is 1.76 inches; length of cut, 1⅜ inches; and hourly production, 72 pieces.

A straddle-milling operation on tool-steel clipper blades is shown in Fig. 11. Two sets of straddle mills arranged for cutter-spindle reversal are used, and stacks of blades are held in fixtures of the vise type. In loading a fixture, a stack of thirty-five blades is obtained without counting, by using a fixture (not shown) which holds just the required number. Pivoted side plates *A*, which are brought up into contact with the work while loading, align the various blades before clamping them in position. These tool-steel blades are milled to size within a limit of 0.002 inch, and the production per hour is 800 blades. The cutters remain stationary during the return stroke, and the cycle of movements is practically the same as explained in connection with Fig. 9.

Duplex Cutter-spindle Attachments

For operations that can be performed to advantage by the use of two end-mills or small face mills for finishing bosses, pads, etc., special two-spindle attachments are used. An example of this class of work is shown in Fig. 12. The operation is that of milling six small pads on the side of a cylinder casting. These pads are in horizontal alignment, and are arranged in two groups of three pads each. One end-mill finishes three pads, while the other is at work on the opposite group, both mills operating on corresponding surfaces simultaneously. The fast travel or "jump" from one pad to another is employed, and after the last surface is milled the spindle stops; the table then returns rapidly to the starting point and stops in the loading position. The main spindle rotates the two auxiliary spindles through spur gearing. These spindles have ball bearings, as well as an adjustment for locating the working edges of the cutters in the same plane. The illustration shows a casting on the table of the machine without the clamping devices.

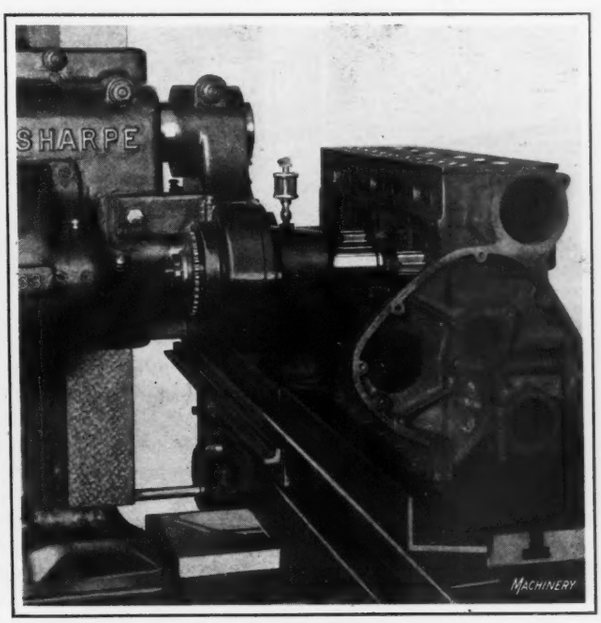


Fig. 12. Application of a Duplex Cutter-spindle Attachment

The application of another two-spindle attachment is shown in Fig. 13. The cylinder casting shown in position for milling has four pads, two of these being opposite the cutters and the other two in corresponding positions at the other end of the casting. The work has been placed on temporary blocks, so as to show clearly its relation to the cutters and the nature of the operation. As the table feeds to the right, two pads opposite the cutters are milled; the rapid travel then locates the two remaining surfaces in the milling position. At the end of the second cut, the spindle stops, the table returns in four seconds, and stops in the loading position. As the cutter-spindles are very short, they are equipped with roller bear-

ings in the rear and plain bearings in the front. Axial adjustment is provided for locating the cutters in the proper relation to each other.

Provision for Alignment of Work with Cutters

It is evident from the foregoing examples of automatic milling that the rate of production may be affected decidedly by the design of the work fixtures. In addition to the speed of loading, accuracy in locating the work relative to the cutters is another point, the importance of which naturally varies according to the kind of operation and the shape of the part, as well as the extent, if any, to which other surfaces have been machined previously. In some cases, the location either laterally or vertically may be important, and in others both directions must be considered carefully.

For certain operations particularly, it is also essential to provide for changes in the diameters of cutters due to resharpening, as, for example, when two cutters or groups of cutters are mounted on the same arbor and used for milling parts held in separate fixtures. An illustration of such a case is shown in Fig. 14. Here the work is held in standard machine vises, and each vise is supported by a baseplate having provision for adjustment. The fixture at the left of the table has lateral adjustment only, while the one at the right has both lateral and vertical adjustment. This independent vertical adjustment is not only a convenient feature in setting up the machine, but also provides means of relocating the fixture whenever this is necessary, due to a change in cutter diameter resulting from resharpening. The two screws *A* and *B* provide the necessary lateral adjustment, and screw *C*, by shifting a wedge-shaped plate, effects the vertical adjustment.

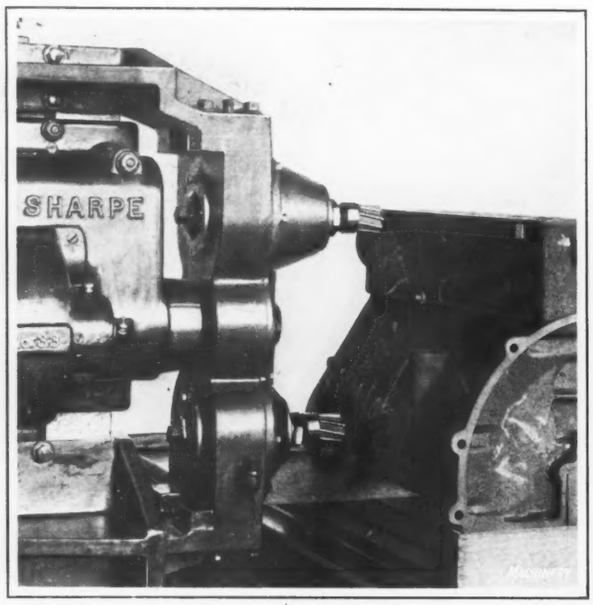


Fig. 13. Another Form of Duplex Cutter-spindle Attachment

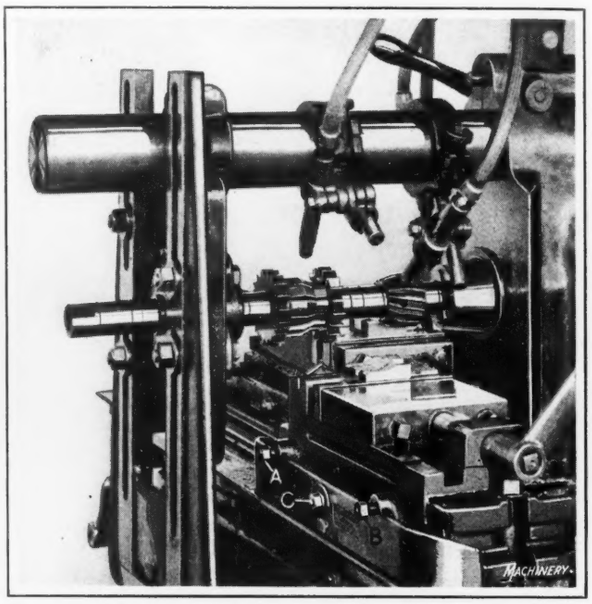


Fig. 14. Fixtures which provide Lateral and Vertical Adjustment

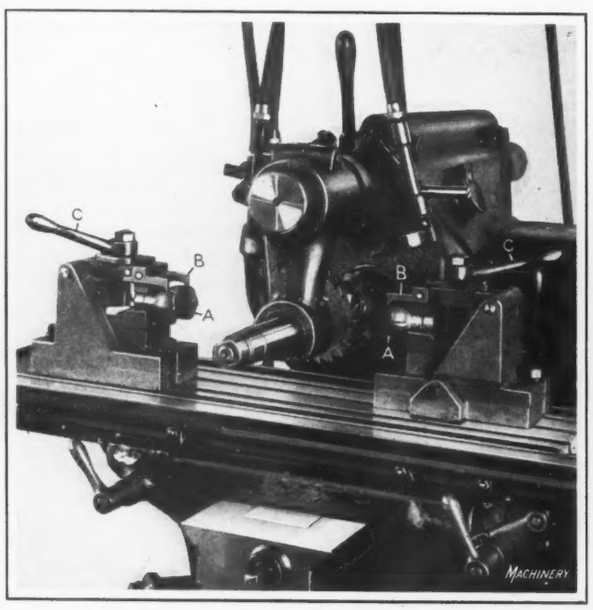


Fig. 15. Machine arranged for milling Inner Faces of Sleeve Yokes

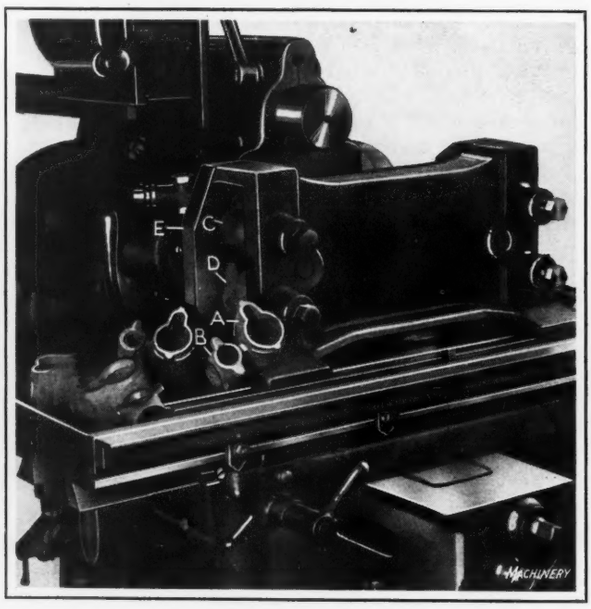


Fig. 16. An Example of Face Milling on an Automatic Machine

The operation illustrated is that of form-milling small steel pieces having a width limit of 0.002 inch, and a length limit of 0.004 inch. The fixtures are staggered similar to the method employed in some of the operations previously described, since the cutter-spindle is reversed to feed the work against the rotation of each cutter. This operation illustrates a unique possibility of the machine, two different operations being performed on the same piece by the same machine. The piece is rough-formed under the first cutter, then shifted to the second fixture, when it is straddle-milled and the outline finish-formed. While the same piece is used in both fixtures there is no reason why two jobs entirely

foreign to each other cannot be handled in a like manner on the same machine, provided the cutters are of the same or nearly the same diameter, in order that their peripheral speeds will be nearly equal.

Fig. 15 shows a machine set up for milling the inner faces of sleeve yokes. The right-hand fixture in this case has provision for lateral adjustment. For operations of this general character, changes in the cutter diameter due to sharpening would not, of course, affect the work, which is held at approximately the height of the cutter center. The lateral adjustment for one fixture, however, is convenient, especially in setting up the machine.

The sleeve yokes *A*, which are milled, are located horizontally by pivoted locating devices *B*, having projecting fingers which come into contact with each side of the yoke when the latter is properly located. The clamping levers *C* bear against open or slotted washers which are pivoted and swing back to allow the work to be removed after turning a hand-lever just far enough to loosen the washer. The rate of feed for this operation is 1.76 inches per minute, the 5-inch cutters operate at 66 revolutions per minute, and the rate of production is 72 pieces per hour. The action of the machine is continuous, the cutter-spindle rotating constantly in one direction and the table moving continuously from one working position to the other.

Face-milling Operation

The machine illustrated in Fig. 16 is set up for a face-milling operation on cast-iron carburetor bowls. Several of these castings may be seen on the table of the machine. Surface *A* is finished before this face-milling operation, which finishes surface *B*. Two castings are milled simultaneously, as at *C* and *D*, and then the table is traversed rapidly for locating the large face mill opposite another pair of castings at the right-hand end of the fixture. The castings are clamped by the screws shown, against plates, as at *E*, and the part to be finished projects into an opening at the rear of the fixture. An 8-inch face mill is mounted on the end of the spindle, and it has a speed of 66 revolutions per minute. The length of cut is 2 inches, and the production rate, 260 castings per hour.

While all of the foregoing examples represent quantity production, it will be apparent that these automatic machines may readily be arranged for ordinary hand-controlled milling operations whenever conditions warrant such usage. It will also be understood that the examples selected represent only a few of the numerous operations performed on these automatic machines and are intended merely to indicate typical or average practice, both in regard to the classes of work milled and the rates of production obtained under everyday working conditions.

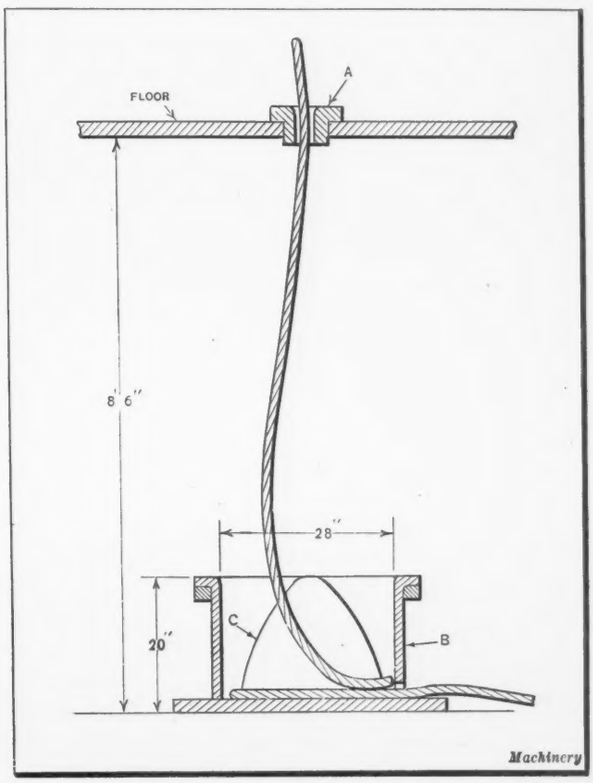
* * *

The growth of the work of the American Engineering Standards Committee is an indication of the growth of the entire standardization movement in the United States. The number of different subjects for standardization that are now under consideration, or that have been completed and the standards approved, is 152. In this work 235 national societies or associations and government bureaus have been cooperating, the number of individuals serving on the separate standardization committees being 1081. Of the subjects for standardization that are either under way or have been completed, 31 have to do with civil engineering and the building trades, 25 with mechanical engineering, 15 with electrical engineering, 4 with automotive engineering, 11 with land transportation, 1 with ships, 14 with ferrous metals, 15 with non-ferrous metals, 12 with chemical subjects, 5 with mining, 5 with the wood industry, 2 with textiles, 1 with the paper and pulp industry, and 11 with matters of a miscellaneous or more general character. Trade organizations are taking a more and more active interest in this work, and of the associations officially cooperating in standardization work over 140 may be classed as industrial or trade associations.

CABLE REEL OF SIMPLE DESIGN

By H. L. WHITTEMORE

The testing machine at the Bureau of Standards, Washington, D. C., on which the cable-coiling device shown in the accompanying illustration is employed, is said to be the largest in the world. It is capable of testing steel columns up to 25 feet in length and can exert a compressive load of 10,000,000 pounds. The adjustment for specimens of different lengths is made by moving the upper head on the supporting screws, a motor at the top of the head being employed to turn the nuts on the screws by means of reduction gearing. The insulated cable, consisting of four stranded rubber covered wires which connect the motor with the electric mains, formerly hung in a loose coil or loop at the back of the machine. As it was desirable to keep this cable out of the way as much as possible, it was decided to provide some kind of take-up reel. Accordingly, prices were obtained on reels of different types, but the only one that appeared to be suitable for the purpose cost



Reel for coiling Electric Cable on Testing Machine

about $395. In addition to the first cost of this reel, there was the expense of renewing commutator brushes and other parts subject to wear. As the expense of such a device seemed too great, the simple coiling reel shown in the illustration was constructed. This proved very satisfactory, and requires little if any attention or expense for upkeep. This reel is only suitable for cables having vertical movements.

The four-stranded rubber covered wires leading from the motor (which was 10 horsepower, operating on 220 volts) were twisted together and bound with tape at distances of 1 foot. A conduit for the cable formed by the four wires extended from the motor to a point just back of and at the right-hand side of the testing machine. The cable, passing through this conduit, hung freely from the head and passed through the bushing *A* in the floor, as shown in the illustration. Bushing *A* is located over the bin *B*, so that the cable is coiled over the conical-shaped inner wall *C* of the bin. The outer walls of the bin are made of wooden slats, a continuous ring being placed around the top to prevent the cable from catching on the ends of the slats. The weight of the cable is sufficient to keep it in a vertical position so that it coils neatly around the conical wall inside the bin.

Notes and Comment on Engineering Topics

The effect of the French occupation of the Ruhr is indicated by the fact that the production of coal in Germany in 1923 amounted to only 62,000,000 tons, as compared with 119,000,000 in 1922 and 140,000,000 tons in 1913.

According to statistics collected by the New York State Bureau of Public Utilities, 39,000,000 people in the United States live in homes lighted by electricity. It is of interest to note that next in order among the nations of the world comes Japan with 23,000,000 people living in electrically lighted homes, and Germany with about 9,000,000.

The Gage Steel Committee of the Bureau of Standards, Washington, D. C., has issued its Ninth Progress Report on gage steel investigations, containing a review of the progress made up to the present time, dealing with wear tests, dimensional changes due to hardening, and time changes after heat-treatment. Those interested may obtain copies of the report from H. W. Bearce, secretary, Bureau of Standards, Washington, D. C.

The total number of students at the thirteen leading German engineering schools during the present school year is about 27,500, which is more than twice the number that were enrolled in the same engineering schools previous to the war. The Engineering Institute of Munich, with over 5000 students, is still the most popular of the higher engineering schools. Charlottenburg, near Berlin, comes next with 4700 students, and is followed by Dresden with 4000 students.

The chemical element zirconium has an exceptionally high melting point—above 4000 degrees F. It is similar to gold and platinum in that it is not attacked by any of the ordinary acids. Efforts have been made to introduce zirconium in alloys for cutting metals, but as yet this process has not reached its final development. In the manufacture of white enamelware, zirconium is now being used to produce a glaze that will resist the action of acids. The metal already plays an important part wherever either high temperature or high voltages are met with in electrical engineering.

The average price of manufactured commodities is, at the present time, 62 per cent above the average price of the same commodities in 1913. The cost of farm products is 50 per cent above the 1913 price; building materials are 120 per cent in excess of the pre-war figure; while automobiles sell at approximately the same price, and copper sells for less than it did ten years ago. Based upon present indications and past experience, it would seem that when prices finally become definitely stabilized, the average price level will be between 50 and 60 per cent higher than the price level of 1913.

Reports from Russia indicate that the production of platinum increased slightly in that country in 1923 as compared with 1922, but the supply of platinum from Russia that the world mainly counted upon before the war, is still negligible—hence, the great increase in the price of platinum during recent years. An additional cause for the high price is that as soon as platinum became more costly than gold, it immediately was introduced in the jewelry trades as a setting for precious stones, a use which was not thought of when platinum was a comparatively cheap metal. The present price is about $125 an ounce, as compared with about $35 an ounce before the war.

At the end of 1923 there were 15,281,295 motor vehicles registered in the United States, adding over 2,915,000 to those registered a year previously. In view of the fact that there were somewhat over 4,000,000 motor vehicles built during the year, it appears that nearly 1,100,000 cars were used for replacement purposes. There is one motor vehicle in this country for every 7.2 persons. Their owners paid $190,000,000 in fees and taxes into the state treasuries last year. Of the new cars registered, about 11 per cent were commercial vehicles. The states with the largest number of automobiles in the order of their importance are New York, California, Ohio, Pennsylvania, and Illinois.

The French Parliament has passed a law approving a project for the erection of a power plant utilizing tidal energy. The construction will involve a dam of 150 meters and four groups of turbines, operating both on the inflow and outflow of the tide, with power ranging from 75 to 1200 horsepower when running at various speeds. The use of the tides will be carried on with that of the water power drawn from a fresh water stream in the neighborhood, thus making it possible to regulate the total power produced. Fresh water and tide plants combined will furnish a minimum of 1600 horsepower and a maximum of 3200 horsepower.

A small self-contained light and power plant which can be used without a battery has been developed by the Westinghouse Electric & Mfg. Co. for service where the electric current can be turned directly into the line. This small power plant is portable, and is well adapted for service in the oil and gas fields, and in mines, quarries, construction camps, lumber camps, brickyards, as well as on barges, boats, and dredges. The plant operates on kerosene or natural gas, and has a capacity of 1500 watts at 110 volts. It consists of an engine and electric generator built into a single compact unit. The engine is air-cooled so that it can be installed into an unheated place, and has a capacity for sixty 25-watt lamps, or will deliver current equivalent to about 1½ horsepower.

The great importance of research work in the progress of the automobile industry, in order to obtain thorough and systematic data on basic, practical problems, is well recognized by the Society of Automotive Engineers, and the research committee of the society has now before it several important research problems, which will receive attention during the coming year. One of these relates to automotive fuels, and another, of especial interest to mechanical men in general, relates to gears. Smoothness of operation, and freedom of noise and vibration are some of the factors involved in gear design that are as yet far from being satisfactorily solved. For this reason the research committee of the Society of Automotive Engineers is undertaking to investigate this problem. In this connection it is planned to hold a meeting at some general session of the society, at which gear matters can be discussed and definite plans for active research work made.

Unusual Engine Lathe Operations

Prize-winning Articles in MACHINERY's Contest on Interesting Lathe Practice—Second Installment

ADAPTING THE LATHE TO PRODUCTION WORK

By JOSEPH LANNEN

The lathe is not usually considered a production machine. Properly equipped, however, it can be transformed into a machine of remarkable production capacity, as in the case of the lathe shown in Fig. 3. This lathe is used to finish-turn and face the gray iron casting shown in Fig. 1, which has previously been rough- and semi-finished on an automatic screw machine and had the bores at *A* and *B* hand-reamed to size. The cylindrical surfaces *C*, *D* and *E* must be turned accurately to size and must be concentric with the bores within a limit of 0.002 inch. The faces *F* and *G* must not run out of true with the bores more than 0.001 inch.

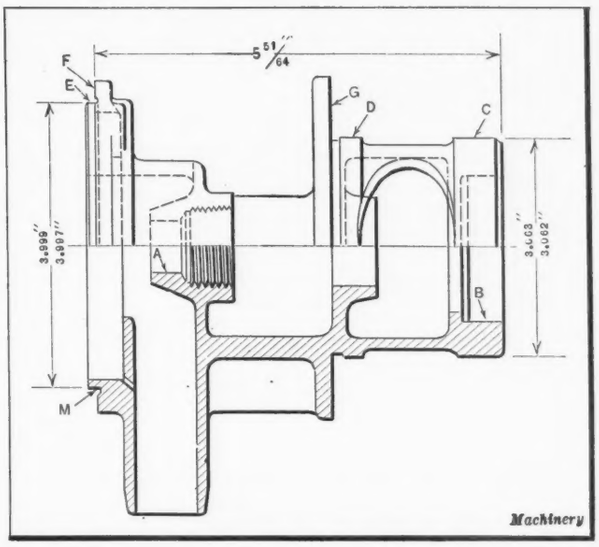


Fig. 1. Casting machined on Specially Equipped Lathe shown in Figs. 1 and 2

The surfaces *C*, *D* and *E* are turned to the required diameters by the undershot tools *C*, *D* and *E* shown in Fig. 2. These tools are set in a special tool-block attached to the cross-slide, and are inclined at an angle of 7 degrees to give clearance and provide means for adjusting them to cut the proper size. They are given a rake on the cutting edge to lighten the cut, so that the work, which is carried on an arbor, will not spring away from the cutter and make it difficult to hold the size within the required limits. These tools are set so that only one of them cuts at a time. The two facing tools *F* and *G* start to cut after the three tools *C*, *D* and *E* have completed their respective cuts. Tools *F* and *G* are located in the proper longitudinal relation to the work by the indicator *H*. When this indicator touches the semi-finished face and is brought to a zero reading by moving the carriage, the cross-feed is engaged and the indicator is swung out of contact with the work. The object in using this indicator is to equalize the depth of the cut on each of the flanges.

When these tools, which cut from the outside of the work toward the center, have completed their cuts, the cross-slide is stopped automatically by the arrangement shown in Fig. 3. A wedge *J* projects from the front of the tool-block, and as the table advances toward the operator, it comes into contact with the vertical pin *K*, forcing the pin down until it engages the projection on the feed-nut. This stops the nut and throws out the feed. The tool *L* is then pushed in by hand to produce the under-cut at *M*, Fig. 1.

The method of operating is as follows: An arbor is inserted in the casting, and the work mounted between centers. The machine is started, after which the indicator is

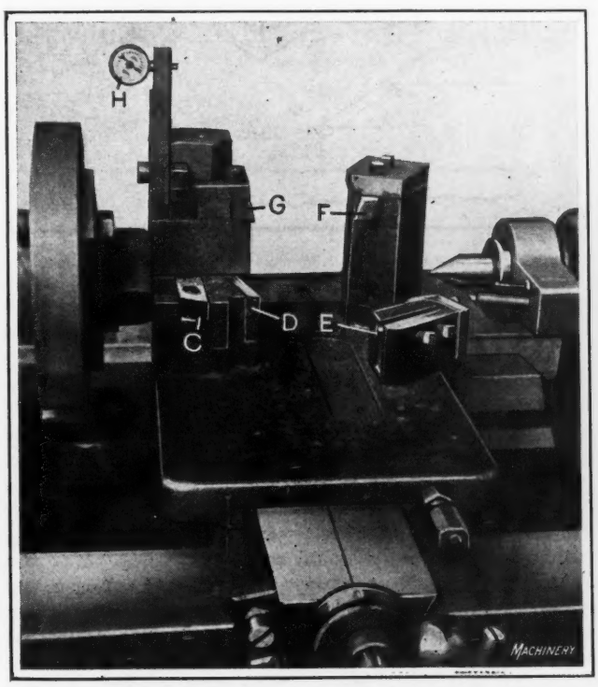


Fig. 2. Special Tool Equipment used in machining Casting shown in Fig. 1

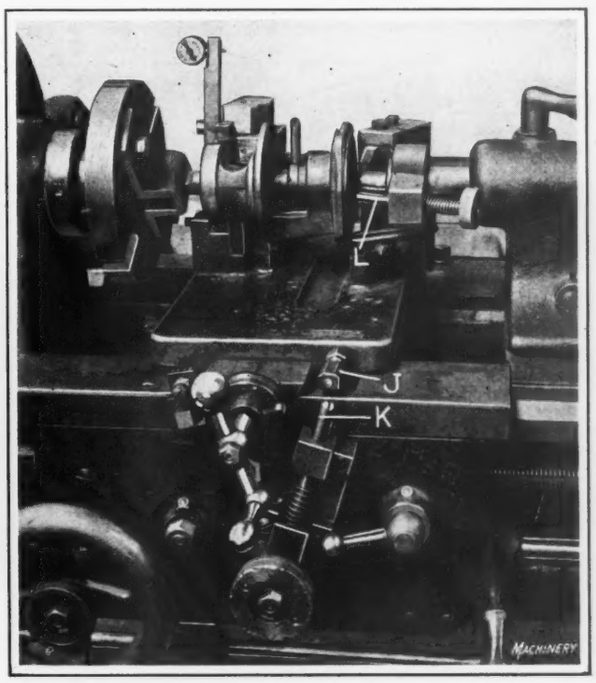


Fig. 3. View showing Lathe with Work in Place Ready for Machining Operation

swung into engagement with the casting, and the carriage is set in its proper position. The cross-feed is then engaged by turning the feed-nut, and the tools are fed into the work, the direction of the feeding movement being toward the front of the lathe. While the cut is being taken, the operator removes the arbor from the piece just completed and inserts it in a fresh casting. When the feed is automatically thrown out, the cross-slide is returned to the starting point by the hand feed. The completed piece is then removed and the one just mounted on the arbor placed in the lathe.

Thus it is only necessary for the operator to engage the feed to cause five tools to pass over the work, since all of the cuts are taken as the cross-slide travels in one direction.

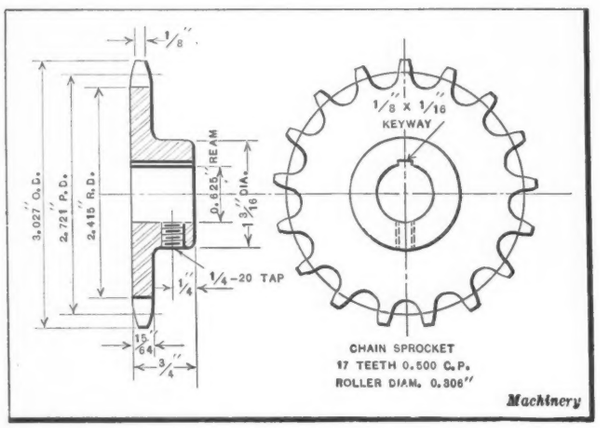


Fig. 1. Sprocket Wheel machined in a Lathe

It would be difficult to maintain the accuracy required on the various diameters except by the use of undershot tools, because with these tools the strain is taken directly on the ways of the lathe, and the tendency of the tool to spring is reduced to a minimum. The production time for this operation is 1 minute 10 seconds, from floor to floor.

MAKING SPROCKETS IN A LATHE

By ANDREW J. WEIS

Several years ago the writer built a machine which required four roller chain sprocket wheels like the one shown in Fig. 1. The experimental and therefore uncertain nature

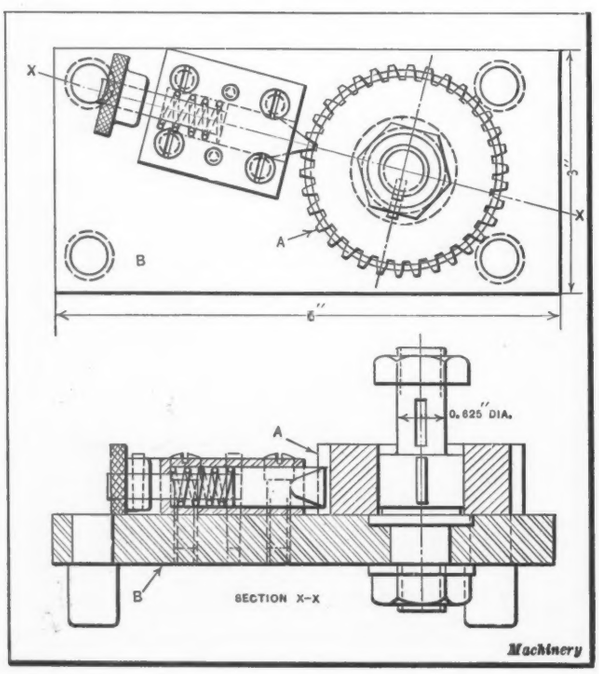


Fig. 2. Indexing Device used in drilling and boring Tooth Spaces

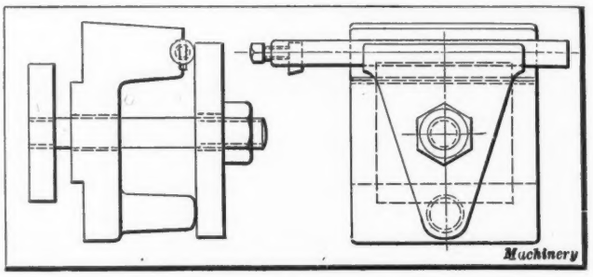


Fig. 3. Fixture and Tool used in cutting Keyway

of the work, made economy one of the first considerations. The price quoted by several concerns specializing on sprocket wheels was $3.20 per wheel, with eight weeks as the earliest date of delivery. Under these conditions the writer decided to make the sprockets himself, even though his equipment consisted of nothing more than an engine lathe and the usual tool equipment.

The first step was to design an indexing fixture for use in cutting the teeth. In this fixture, which is shown in Fig. 2, a cut spur gear *A* was used as a spacer or indexplate, and a piece of scrap wrought iron was machined to form the base *B* of the fixture. These parts and the minor pieces were obtained at a very small cost. All the work was done on the lathe, and the total time for completion was

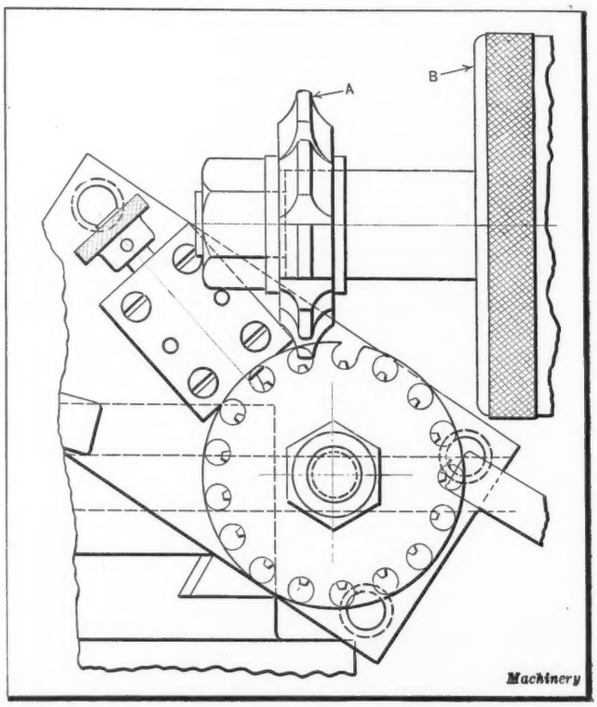


Fig. 4. Method of milling Addendum of Sprocket Wheel Teeth

just five hours. One of the first jobs was to make a pattern for the sprocket blanks and obtain castings from the foundry.

The castings were bored out and the keyseats cut at one chucking in the lathe. The boring was done with standard tools, but the keyseating operation required the use of the special tool shown in Fig. 3, which had been used many times before for cutting straight keyseats. The castings for the sprocket blanks were turned on an arbor. A button was then located on the pitch circle of one of the finished blanks so that the pitch radius could be checked. The blank was next put into the fixture shown in Fig. 2. This fixture was clamped to the lathe faceplate, as shown in Fig. 5, the button being used to bring the work into the correct position for drilling one of the tooth spaces. A 19/64-inch hole was then drilled for each tooth space. This allowed 0.009 inch for boring out to the required 0.306 inch diameter, or the exact

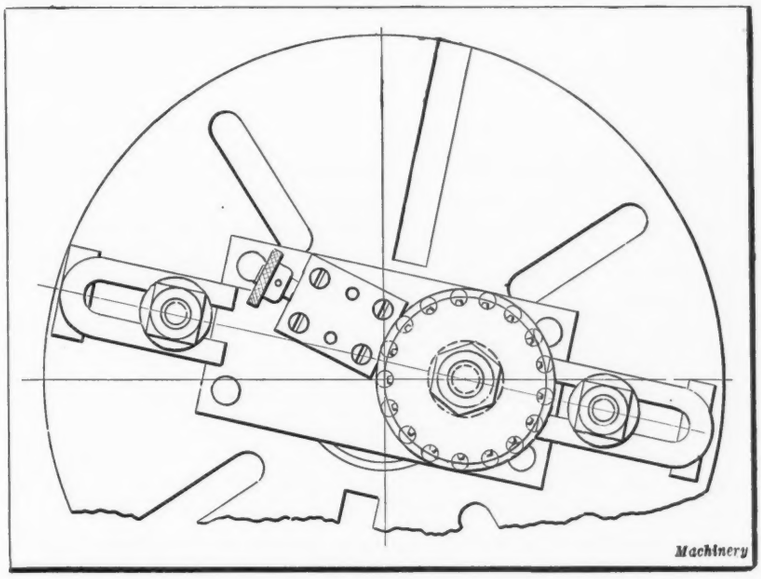


Fig. 5. Diagram showing Indexing Device mounted on Lathe Faceplate

size of the chain rollers. A plain boring tool was used for this operation, and this was not moved, except to compensate for cutter wear, until the sixty-eight holes in the four blanks had been bored to size.

HOBBING PIPE-THREAD DIES

By C. T. KETZ

The accompanying illustrations show the equipment used on an engine lathe for hobbing pipe-thread dies. Most commercial dies do not have relieved threads, and, therefore, the threads are likely to tear or strip whereas the relieved threads, as cut by the method here described, give no trouble in this respect, and in addition, they give a better finish and higher production rate. The equipment consists of a hob *A*, Fig. 1, which is supported at one end by center *C* of the tailstock and at the other (or shank end) by a floating holder *B*. The diameter of the hob is made ½ inch larger than the nominal diameter of the threading dies; that is, the diameter of the hob for the ½-inch pipe was made 1 inch. About one-fourth the total length of the hob is tapered, the rest remaining cylindrical. The shank has a feather key, which fits into a two-lipped driving dog *D*.

The holder *B* is screwed on the nose of the headstock and has four slots in it marked 1, 2, 3 and 4. The die blanks after being machined to the desired sizes, are divided into four even groups, and all the blanks in each group are stamped by the numbers 1, 2, 3 and 4, respectively. When ready for hobbing, the blank is clamped in a jig *E* by means of set-screws *G* and a swinging strap *F*, also equipped with a set-screw *H*. The blank is inclined to conform with the standard angle of the pipe thread, namely, 1/32 inch per inch and is placed slightly above the center

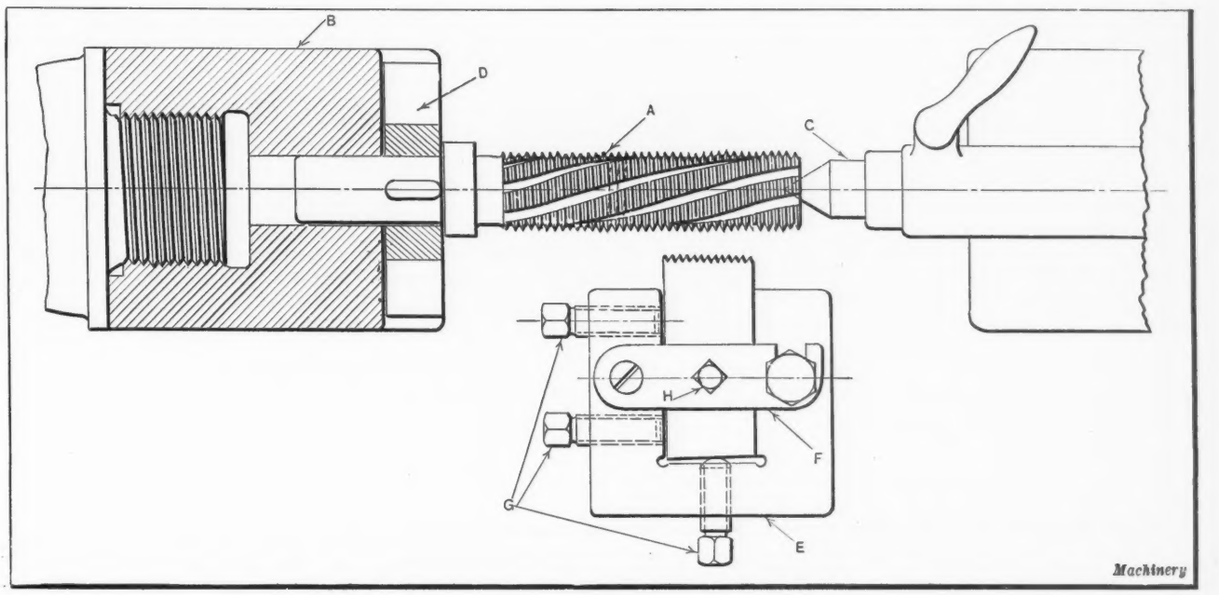


Fig. 1. Engine Lathe Set-up for hobbing Pipe-thread Dies

The fixture was next clamped to the compound rest, as shown in Fig. 4. A standard No. 7 five-pitch bevel gear cutter *A*, mounted on an arbor held in the lathe spindle by means of a homemade chuck *B*, was used to finish one side of the addendum of each tooth of the sprocket. The sprocket was then reversed on the stud, and the unfinished sides of the teeth were milled to shape.

The sprocket wheels produced by the method described were accurately shaped and gave better service than those the writer had previously purchased from a well-known manufacturer. The time required to make the fixture and finish the sprockets was about twelve hours, which, considering the small expense for material, made the actual cost approximately the same as the price quoted by the manufacturer. However, although the cost was as great as though the work had been done by an outside concern, the tool equipment was available for making additional sprockets, which could be made for less, as the time required for making the equipment would not be included.

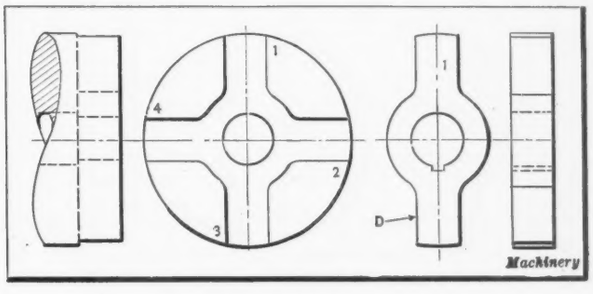


Fig. 2. Special Chuck and Indexing Dog used in making Threading Dies

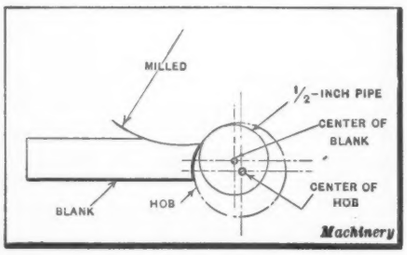


Fig. 3. Diagram showing Method of relieving Pipe-thread Dies

of the hob to provide relief as shown in Fig. 3.

All the blanks marked No. 1 are cut at the same setting, with the wing No. 1 of the driving dog *D* (shown also in Fig. 2) in slot No. 1 of the holder *B*, Fig. 1. When blanks Nos. 2, 3 and 4 are cut, wing No. 1 of the dog *D* is located in slots Nos. 2, 3, and 4 of the holder, respectively. Any set of dies thus hobbed will always match. Usually one or two cuts are necessary to finish the blank, the micrometer adjustment on the cross-slide being used for advancing the blank toward the hob. All forward and backward movements of the blank during the hobbing operation must be made by the lead-screw; that is, during the hobbing of all blanks, the lead-screw nut must not be open or disengaged from the lead-screw. The process of die-hobbing described could be used for any other threading dies, as well as for pipe-threading dies.

* * *

NUMBERING MACHINE PARTS

By T. E. WELSH

Machine part numbers and symbols, besides identifying each machine part, may also indicate their approximate positions on the assembly drawings. This is a great convenience for the checker, and saves time for all who use drawings having many details. Letters, numerals, or combinations of both may be used. Only letters will be considered, however, in the following description.

Before any details are drawn, a detailer assigns a letter to the chief machine part in each functional group of the assembly. Suppose, for instance, that the drawings are for a power press. In this case a list may be pencilled on any assembly somewhat as follows: Crankshaft, A; ram, B; punches, C; etc., until each group has been assigned a letter. If there are more groups than there are letters in the alphabet, two or more groups may share the same letter. All the machine parts comprising each group, and all adjacent parts not in another or separate group, will be known by the group letter.

Each sheet in the set of drawings will also be assigned a letter, beginning with A in the assembly sheets. This system of numbering will be extended to the detail sheets as each is made. Every machine part shown on each sheet will also be assigned a letter when it is detailed, beginning with part *A*. If, in a set in which there are four assembly sheets A, B, C, and D, any machine part from the crankshaft group A is the first part detailed on a fifth sheet E; its full symbol will then be A. E. A. The first letter always denotes the group, the last letter the detailed part, and the intermediate letters, or numbers, the sheet. If, in the same set, any machine part in the punch (C) group is the fifth detail E on the fourth sheet H of details, its full symbol will be C. H. E. It might be more convenient to number the detail sheets instead of lettering them. In that case A. E. A. would become A. 5. A. and C. H. E. would become C. 8. E.

As the full symbols are placed on the assembly sheets, they naturally fall into groups, each symbol of which begins with the same letter; and so each group is found easily and also the machine part sought, for it must be in its particular group whether any group of parts is scattered among many detail sheets, or many groups are on one sheet.

With the plan described, all castings may be detailed on the first detail sheets made (a distinct advantage on rush jobs) without making it difficult to find them on the assembly sheets. No names are needed to help identify the parts, and the symbols to be stamped on each part are short.

CUTTING METRIC THREADS WITH AN ENGLISH LEAD-SCREW

By FREDERICK J. NAAB

A method of setting over the tailstock of a lathe equipped with an English lead-screw in order to cut metric threads was described in April MACHINERY on page 630. While the method described may give results sufficiently accurate for some purposes, the thread will not have a true helical form, but will be what is commonly termed a "drunken thread." This is clearly explained on page 239 of "Handbook of Small Tools," by Erik Oberg.

A table of ratios for use in selecting change-gears for cutting accurate metric threads with a lathe equipped with an English lead-screw is given herewith. The method of using this table will be clear from the following example: Let it be required to cut a 3-millimeter pitch screw thread in a lathe provided with a lead-screw having 6 threads per inch. We first find the approximate ratio or fractional equivalent, in inches, of 3 millimeters. Referring to the table, this is found to be $\frac{17}{144}$. Now as the number of threads per inch of the lead-screw multiplied by the pitch equals the change-gear ratio, we have:

$$6 \times \frac{17}{144} = \frac{17 \times 4}{24 \times 4} = \frac{68}{96}$$

The number of teeth required in the driving gear is indicated by the numerator of this fraction, and the number of teeth in the following gear by the denominator. The error when using this combination of gears in cutting a 3-millimeter pitch screw thread, is 0.000055 inch.

As another example, let it be required to cut a 12-millimeter pitch thread in a lathe equipped with a change-gear box. Now it will be seen from the table that 12 millimeters equals about $\frac{17}{36}$, the error being less than 0.0005 in one inch. The lead-screw can be assumed to have any pitch within the range provided for by the gear-box. In this case we will assume that the pitch of the lead-screw is 2, and we accordingly set the levers on the gear-box to cut 2 threads per inch. We now have the equation:

$$2 \times \frac{17}{36} = \frac{17 \times 4}{18 \times 4} = \frac{68}{72},$$

The driving gear will, therefore, have 68 teeth and the following gear 72 teeth. The change-gear ratios can, of course, be multiplied by any number to suit the gears available. The common practice is to use a 127-tooth gear to cut metric threads, but with these ratios it is possible to cut metric threads in which the error is very small.

TABLE OF RATIOS FOR USE IN SELECTING CHANGE-GEARS FOR CUTTING METRIC THREADS

Millimeters	Decimal Equivalents, Inches	Approximate Ratios	Decimal Equivalents of Approx. Ratios, Inches
1	0.03937	17/432	0.039352
1½	0.05906	17/288	0.059028
2	0.07874	17/216	0.078704
3	0.11811	17/144	0.118056
4	0.15748	17/108	0.157808
5	0.19685	85/432	0.196760
6	0.23622	17/72	0.236112
8	0.31496	17/54	0.314816
10	0.39370	85/216	0.393520
12	0.47244	17/36	0.472222
16	0.62992	17/27	0.629630
18	0.70866	17/24	0.708333
20	0.78740	63/80	0.787500
24	0.94488	17/18	0.944444

Machinery

Design of Magazine Carriers and Slides

By ALBERT A. DOWD

IN transferring parts from a magazine chute or hopper to the cutting position in an automatic machine, a carrier or some other mechanical means is required, unless the work can be fed directly by gravity. The important factors in designing a carrier are shape of work, form of magazine, method of transferring work from carrier to holding units, and method of holding the work. If an automatic machine is to be designed for continuous work on the same piece day after day, it is not necessary to provide adjustments, except for taking up lost motion and wear. However, it is well to remember that a standard product may be redesigned and that even minor changes in size or shape may make it necessary to adapt the machine to new conditions. It is nearly always possible, without much extra expense, to provide for such contingencies in designing, and it is therefore advisable to make locating points, guides, stroke of carrier, etc., adjustable within reasonable limits.

Points Involved in Designing a Carrier

Let us consider the conditions encountered in designing a carrier for delivering bars from a magazine to a chucking device in which the work is held on centers and gripped on the outside by floating jaws. The easiest way to determine the points of importance in developing any design is to consider the things that must be done. In this case, the work must fall from the magazine into the carrier, which must move over toward the supporting centers, and at the end of the travel, the work must be pushed out of the carrier and gripped by the chuck; the carrier must then move back into position for receiving another piece from the magazine. It is evident that the work must be properly located in the carrier and perhaps held in a fixed position while the carrier moves forward to the chucking position. At this point any device used for holding the work must be positively released, leaving the work free to be pushed forward as required. Provision must also be made for returning the carrier without interfering with the piece that is left on the centers.

It will be assumed that the magazine delivers the work to the carrier in a position parallel to the axis of the centers on which it is to be placed. The problem, then, is to move the work in the carrier from the magazine toward the front of the machine, until it reaches position *A*, Fig. 1, which represents a plan view. At this point it is pushed forward out of the carrier by a movement of the tailstock center, until it is located on the two centers and gripped by the floating jaws of the chuck.

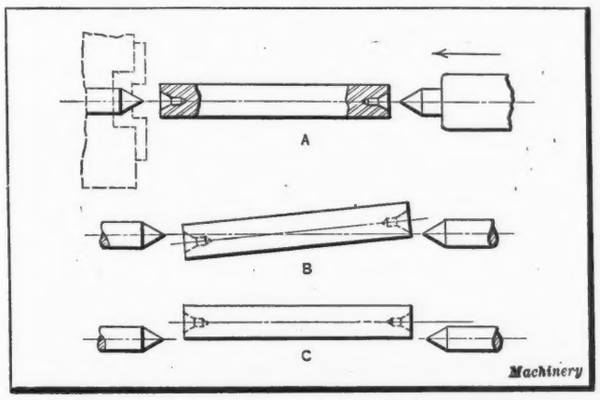


Fig. 1. Diagrams showing Proper and Improper Methods of delivering Bar Work to Centers

The carrier must not interfere with the longitudinal movements of the work nor cause it to assume an incorrect position in relation to the centers or the chuck. At *B* is shown, exaggerated, a condition that might obtain if the work were located improperly in the carrier. In such a position, the centers would not enter the countersunk ends of the work and trouble will result. Of course, the centers will align work when it is not badly out of alignment, but they can only justify a certain amount of error. Then, again, the work may be parallel with the centers, but above, below, or at one side of them, as shown at *C*. Such a condition should exist only when the carrier supports are poorly designed, allowing chips or dirt to collect on the bearing seats, or when the adjustments for the carrier movement are loose or incorrectly set.

Carrier Supports

Several examples of carrier supports for bar work are shown diagrammatically in Fig. 2, that at *A* being a plain V-form with one portion hinged at *D* to permit its withdrawal from the work after the latter has been placed on the centers. This design can easily be made adjustable by slotting the hole provided in the swinging piece for the hinge-pin, thus permitting a change in the relation of the two sides of the vee to suit different diameters of stock. A spring *E* is needed to hold the hinged portion in position, and this spring must be stiff enough so that it will not be depressed by the weight of the work. It must be so located as not to interfere with other parts of the mechanism.

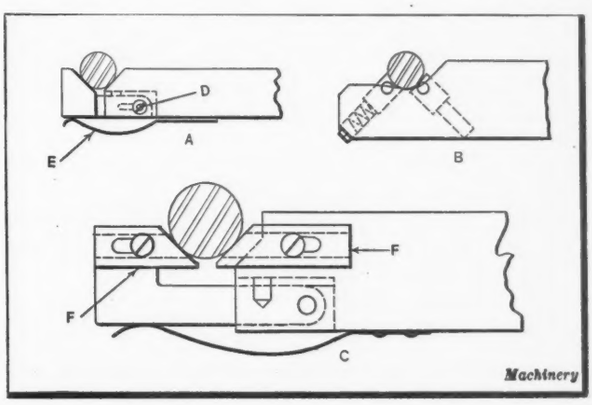


Fig. 2. Examples of Different Methods of supporting Cylindrical Work in Carriers

In example *B*, the work is supported on two pins, one of which must either be of a spring-plunger type or held in a portion of the carrier that is hinged as in the preceding example. There are some advantages obtained in using a construction like this. It is simple and not likely to get out of order nor change its position in an operation. Another advantage is that the pins do not collect chips or dirt and can easily be replaced if worn or broken. Also, it is easy to provide an adjustment for various kinds of work.

In the final example *C*, the carrier is provided with two strips *F*, both of which may be made adjustable, or one fixed and the other adjustable, according to conditions. This question depends somewhat on the arrangement used to regulate the stroke of the carrier. If the stroke is not adjustable, both jaws of the vee must be adjustable, as otherwise they could not be arranged to receive and center the work properly. In this type of carrier also, one of the jaws must be hinged to allow easy withdrawal after chucking.

Examples of Carrier-slide Design

Fig. 3 shows the arrangement of the magazine, carrier-slide, and carrier on an automatic machine handling bar stock. The work falls from the magazine to carriers *A* which are mounted in slides *B*. These slides, in turn, rest in saddles at *C*, which are adjustable lengthwise on a dovetail way extending longitudinally at the rear of the machine. The carriers and slides are moved back and forth across the machine by the bar *D* which passes through a boss at the rear of each slide. This construction permits longitudinal adjustment of the slides without disturbing the feeding mechanism.

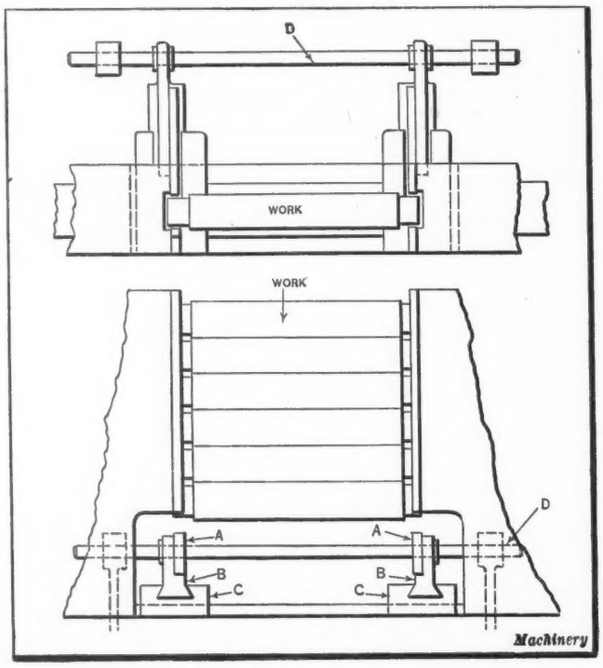


Fig. 3. Arrangement of the Magazine, Carrier-slide, and Carrier on an Automatic Machine

Another construction is illustrated in Fig. 4, in which carrier *A* is a steel bar which is adjustable on slide *B*. The latter part is an iron casting, ribbed for stiffness, and dovetailed to fit saddle *C*. A taper gib *D* provides adjustment for wear. Carrier-slides should always have a long bearing in the saddles, extending out if necessary, as at *Y*, with an extension on the saddle serving as a support. The shaft used to move the carrier-slides backward and forward passes through the hole in boss *E*, and is a sliding fit in the hole so that the carriers may be readily adjusted for long or short work without disturbing any other mechanism.

Saddle *C* can be adjusted along dovetail *F*, after loosening gib *G*, which should again be tightened when the desired positions are reached. Adjustment of the carriers on the slides is possible by means of the slotted holes *H*. Portion *J* of the vee into which the work falls is hinged and supported by a flat spring as before, a slotted hole again permitting adjustments for diameter. Stud *S* limits the upward movement of jaw *J*. The dotted lines at *K* illustrate the operation of the swivel jaw when withdrawing from work placed on the machine centers.

In detail *X*, the magazine supports are dovetailed at *L* to receive the carrier-slide *M* to which the carrier *N* may be fastened in any convenient way, so long as it is adjustable to some extent. There are both advantages and disadvantages in this construction, one advantage being that there are fewer pieces in the mechanism and adjustments are therefore simplified. The magazine supports must extend farther to the rear in order to give a long bearing to the slide. One disadvantage is that as the relation between the carriers and the magazine guides must always be the same, no adjustment is possible. A change in relation can only be obtained by substituting an offset carrier or adding special filler blocks between the slide and carrier to bring the latter into the required position. In designing this type of slide, the front face of slide *M* should be about in line with or a trifle back of the adjacent end of the work. In general, it will be found that the ideal construction is one in which simplicity is combined with a compact design requiring a minimum amount of space.

Control of Carrier-slides

The movements of carrier-slides are usually controlled through levers actuated by a cam. The position of the camshaft, timing of the slide movements, and general method of operation are dependent to a large extent on the design of the machine. It is customary to use a single camshaft for controlling the movements in order to avoid the lost motion likely to occur if several shafts were used with intermediate gearing. With all movements taken from one shaft, it is much easier to regulate the timing and there is less possibility of a certain movement starting too late or too early on account of lost motion.

One method of operating a carrier-slide is illustrated in Fig. 5. The work *A* is shown just as it has dropped from the magazine into carrier *B*. Shaft *D* extends through both carrier-slides and enters slots in operating arms *C*, which control the movements. Both arms *C* may be fastened to

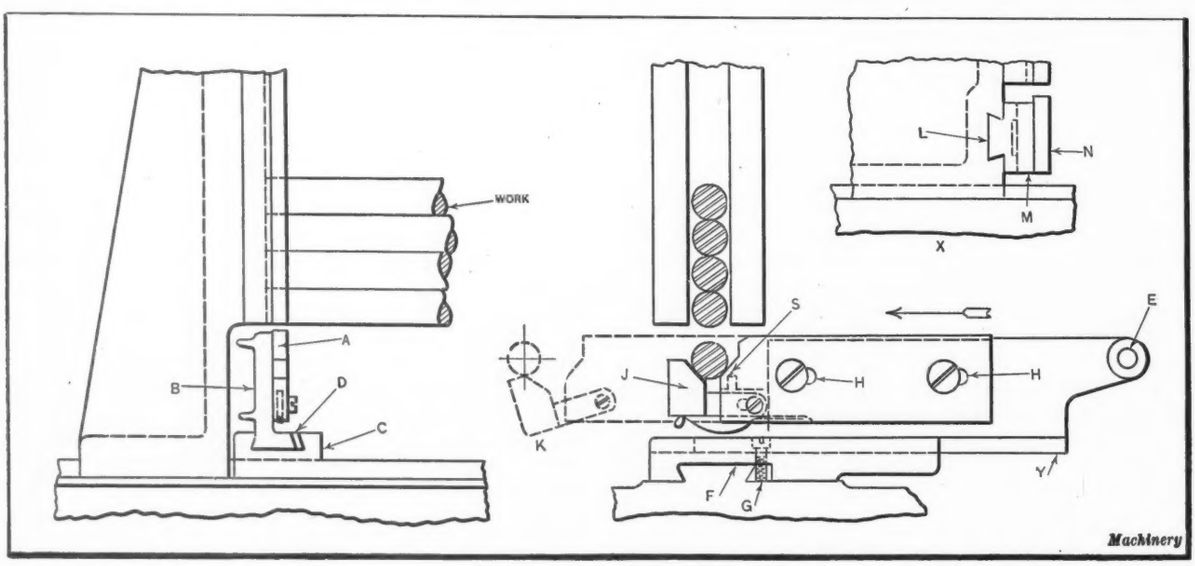


Fig. 4. Carrier-slides, Carrier, and Magazine for Bar Work

pivot shaft *E* by means of keys, pins, or set-screws. Lever *F* has a roller *G* at one end, which engages with a cam *H*, so proportioned as to give the required movements at the proper time relative to other movements of the machine. Spring *K* keeps the roll in contact with the cam. The axis of the camshaft is in line with the work-holding centers.

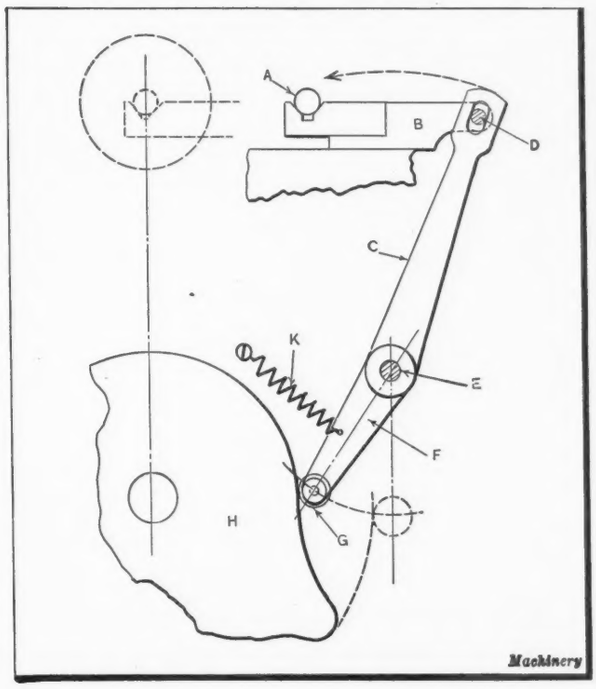


Fig. 5. Diagrammatic View showing One Method of imparting the Forward and Return Movements to the Carrier

Safety Devices for Slides

With automatic machinery there is a possibility that the work may not lie properly in the slide, and this will cause considerable damage unless some provision is made to guard against such a contingency. It is well to anticipate such possibilities in designing by using the imagination and trying to conceive what the result would be if the piece did not fall properly into the carrier. One of the simplest safety devices that can be used for carrier-slides is a friction clutch, so placed that it will not drive the mechanism if an excessive strain occurs.

In Figs. 6 and 7 are shown several examples of clutches suitable for such an application. In Fig. 6 the rocker-shaft is designated by *A*, and on it are mounted levers *B* which control the carrier-slide, only one lever being shown. A friction collar *C*, with a leather disk *D* secured to its face, is keyed or pinned to the shaft. Lever *F* may be a steel or malleable-iron casting or a drop-forging, and is a running fit on the shaft. Roller *H* is held in contact with the cam in a manner similar to that shown in Fig. 5.

The hand-knob *L* is used to compress coil spring *K* and produce the desired friction in the device by forcing the face of the hub on lever *F* against the leather face of collar *C*. The friction should be sufficient to permit the transmission of power to shaft *A* under normal conditions, but the clutch faces should slip when undue resistance is met. As the power required for this particular movement is small, an excessive pressure is not needed. It is an easy matter to regulate the friction by releasing or compressing the spring.

For mechanisms in which only a slight pressure is required, a steel disk *C* working against a cast-iron surface *D*, as shown at *A* in Fig. 7, is often sufficient, the steel disk being pinned to the lever. Another clutch that could be used for the same purpose is shown at *B*. This is of the conical type, possessing considerable pulling power which, of course, is dependent on the angle, diameter, width, etc., of the faces. This type is more expensive than the leather-disk form shown in Fig. 6, and it is not as well suited to the purpose.

Carriers for Irregular Pieces

In handling symmetrical bar work, two parallel carriers of more or less fixed design are almost invariably used, but such forms are not often adapted to the handling of irregular work. Some of the important points that apply in designing a carrier for this kind of work are as follows:

1. The shape of the piece to be held; it is essential to use a carrier that will hold the work invariably in the position required for its proper transfer to the chuck. If the work is fed to the carrier by gravity, and if it is heavier at one end than the other, provision must be made to prevent it from tipping or tilting to one side when entering the carrier.

2. The release of the work as it is transferred; if there is more resistance on one portion than on another, the piece may be forced out of position so that it will not locate properly in the chuck. The pressure of any springs used for holding the work is often a troublesome matter. Experiments are frequently required before the most suitable form can be determined.

3. The return of the carrier to the magazine for another piece; the carrier should not "drag" unduly on the piece that has just been chucked, and it should close as soon as possible after leaving the piece so as to prevent the accumulation of chips or dirt. An air blast can be directed on the locating surfaces just before a new piece of work falls from the magazine, but this is necessary only when a great many chips are formed. Chips and dirt can also be eliminated by means of suitable guards so placed that they will not interfere with the work.

For certain kinds of irregular work, the carriers previously mentioned can be used, it being possible to make adjustments to suit conditions. When work of larger diameter is to be handled, however, another form is sometimes required, in which only one slide is used. Fig. 8 shows an example of this kind, which can be used when the magazine is arranged at the back of the machine. The work is contained in a vertical magazine *A* as indicated, and fed by gravity into carrier *B*. This piece of work has a chucking

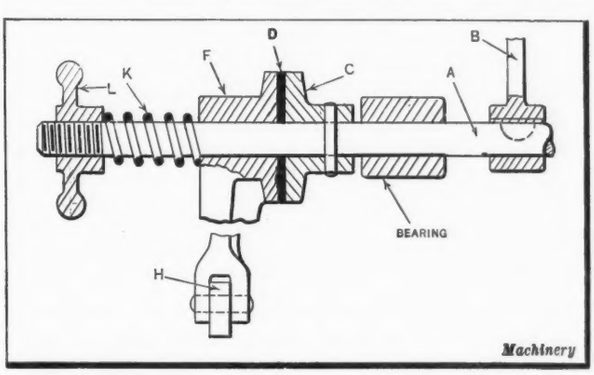


Fig. 6. Friction Clutch which may be applied as a Safety Device to Carrier Mechanisms

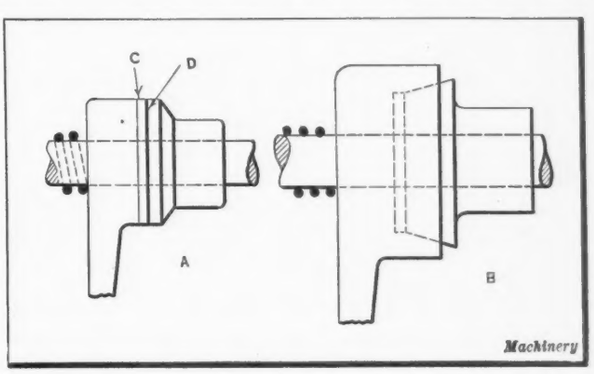


Fig. 7. Two More Friction Clutch Designs which may be used with Carriers

stem *C*, as illustrated clearly in the enlarged view *Y*, which is grasped in the jaws of a special chuck. As the work lies in the carrier, it is in front of the chuck, and so it must be pushed to the left to bring it into a position where the chuck jaws can seize it. This is accomplished by means of a pusher-rod on the turret of the machine and by a carrier design that readily releases the work.

Attached to the front side of parts *B* and *D* are three leaf springs *E*, mounted as clearly shown in the enlarged detail. The springs are made of sheet metal, bent over on each side to form a lug *F* adjacent to the walls of the carrier and assembled with a pin to form a hinge. Another spring *G* normally holds each spring *E* upright. On the opposite side of the carrier from the chuck, are three guard plates *H* which, in combination with springs *E* and the vee, form a more or less flexible "nest" in which the work is held upright while it is carried forward into the hucking device. When the carrier reaches this position, the turret pusher-rod advances and pushes the work past springs *E* into the chuck.

The carrier must make the forward motion without interference and must withdraw after the work has been chucked. In addition, it must hold the work approximately upright while moving from the magazine to the chucking position. A carrier having a wide range of adjustment is not always required for this kind of work, although it is advisable to provide a limited amount of adjustment to take care of normal variations in the size of work and to provide for minor changes in the design. This can be easily done by making member *D* separate from the carrier so that it can be moved backward or forward with relation to the other side of the vee.

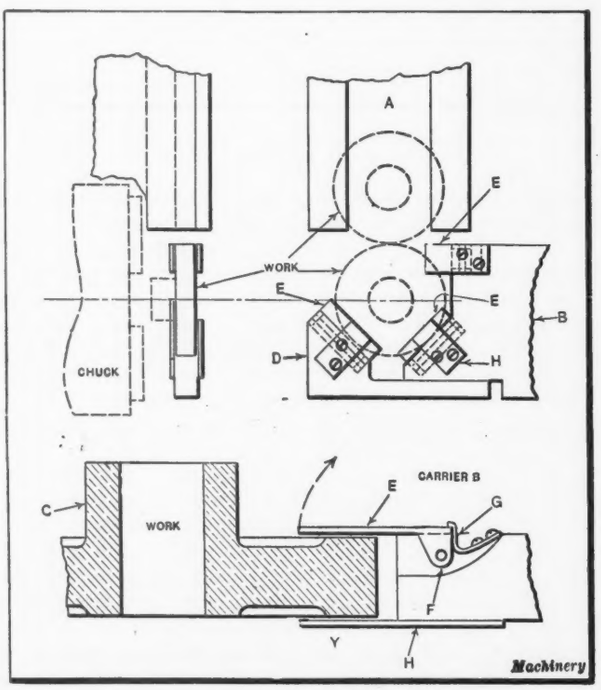


Fig. 8. Carrier in which the Work is held by Means of Springs that open up in placing the Work in the Chuck

Occasionally the same device may be used for several pieces, while in other cases it must be made to suit the particular piece. The method of holding the work in the carrier and the type of chuck employed affects the design to some extent. A similar spring valve arrangement can be applied to various forms of carriers, whether the magazine is at the rear of the machine, near the chuck, or above the turret. The requirements are that the carrier shall locate the work properly for chucking, hold it securely while moving into position, and release it readily when placed in the chuck.

Every form of carrier has its own peculiarities, and the designer must be continually on guard to avoid overlooking some small matter that would vitally affect the functioning of the mechanism. For example, when protruding chuck jaws are used for holding the work, if the chuck is stopped in a certain position when the piece is inserted, the position of the jaws may affect both the carrier and the pusher by means of which the work is inserted in the chuck. Also, when the work is picked up by a moving chuck, it may be necessary to so design either the carrier or the pusher that a certain portion can revolve while the work is being inserted in the chuck. Conditions like this tend to complicate the design and make it more difficult to avoid "hitches" in the operation.

It is not possible to give much information of value applying to conditions of this kind; the solution of such a problem is dependent largely upon the skill of the designer. Experiments with wooden, tin, or pasteboard models are almost always necessary in order to develop a scheme that will produce satisfactory results. The preliminary idea can often be worked out on paper in proper proportion in order to make sure that it can be applied to the machine, but before perfecting the design, it is highly important to test the working in the manner mentioned.

* * *

A PRIZE FOR AERONAUTICAL ACHIEVEMENT

To commemorate the pioneer achievement in aeronautics of the Wright brothers, the Dayton Section of the Society of Automotive Engineers proposes to give a medal annually as a prize for the most meritorious contribution to the science of aeronautics reported to the section during the year. The contribution to, or the discovery in, the science and art of aeronautics may include advances in aerodynamics, development in the construction of airplanes, their power plants, and accessories, which will increase their efficiency or reliability in performance or flight, such as fuel systems, control mechanisms, instruments for aerial navigation, and the like. Improvements of a nature having mainly a military application, such as ordnance or aerial photography, are not included in the list of subjects for which this prize may be awarded. It is the intention to award the prize for contributions designed to stimulate increased non-military use of heavier-than-air craft.

The prize may be competed for by any individual citizen of any country, or group of not more than two individual citizens. The award will be made for the intrinsic merit of the achievement itself, rather than for the merit of the paper describing it. Flight tests are considered highly desirable, and it will be advantageous to the competitor to be able to include in the paper a complete report in regard to flight tests carried out under proper conditions in the presence of unbiased observers. Flight tests, however, will not be absolutely insisted upon, as it is recognized that a proposed improvement might be such that tests by an individual would be financially impossible and yet the improvement would be clearly evident. The papers should be forwarded to the Wright Memorial Committee, Dayton Section, Society of Automotive Engineers, Inc., care of the Engineers' Club of Dayton, Dayton, Ohio.

The paper describing the achievement for which the medal is awarded shall be presented originally before the Dayton Section of the Society of Automotive Engineers, either by the prize winner or, if this proves impracticable for any reason, by some member of the local section appointed by its officers. The award for 1924 shall be on the basis of papers received up to December 31, 1924.

* * *

The Austrian machinery industry has recovered from the crisis which developed in September, 1922, and is now working at from 90 to 95 per cent of full capacity, according to a report from Vienna. Under normal conditions this industry includes 200 factories and about 30,000 workers.

CUT OUT ON THIS LINE

CUT OUT ON THIS LINE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. ○ PUNCH

WEIGHTS OF CASTINGS

WEIGHTS OF CASTINGS FROM WEIGHTS OF WHITE PINE PATTERNS

Weight of Pattern, in Pounds	Type of Castings					
	Cast Iron	Yellow Brass	Gun Metal	Zinc	Copper	Aluminum
5	74	83	87	72	88	27
10	147	165	173	143	175	53
15	220	247	259	214	263	80
20	294	329	346	286	350	106
25	368	412	433	357	438	133
30	442	495	519	428	525	159
35	515	577	606	500	613	186
40	588	660	692	571	700	212
45	662	742	778	642	788	239
50	735	825	865	715	875	265
55	810	908	951	786	963	292
60	883	990	1040	857	1050	318
65	956	1072	1125	930	1138	344
70	1030	1154	1210	1001	1225	371
75	1103	1236	1298	1072	1312	398
80	1176	1320	1385	1144	1400	423
85	1249	1402	1470	1216	1488	450
90	1322	1484	1558	1286	1575	477
95	1395	1567	1645	1357	1662	503
100	1470	1650	1730	1430	1750	530
105	1543	1730	1819	1500	1838	556
110	1616	1815	1905	1571	1925	583
115	1689	1900	1990	1642	2013	610
120	1762	1980	2080	1713	2101	636
125	1835	2062	2160	1784	2189	663

In the table above, the weight of white pine patterns is multiplied by 14.7 to give the weight of cast iron; by 16.5 for yellow brass; by 17.3 for gun metal; by 14.3 for zinc; by 17.5 for copper; and by 5.3 for aluminum castings. The figures in the table are to be used as a general guide only, because an appreciable difference in the specific gravity of different pieces of the same kind of wood is frequently found. When very accurate estimates are required, the specific gravity of the metal from which the casting is made must be ascertained, and the volume of the casting carefully calculated.

Copyright, 1924, by The Industrial Press, New York

MACHINERY'S Data Sheet No. 40, New Series, August 1924 Contributed by L. H. George

CUT HERE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. ○ PUNCH

WEIGHTS OF CASTINGS

WEIGHTS OF CASTINGS FROM WEIGHTS OF BAYWOOD PATTERNS

Weight of Pattern, in Pounds	Type of Castings					
	Cast Iron	Yellow Brass	Gun Metal	Zinc	Copper	Aluminum
5	44	50	52	43	53	16
10	88	99	103	85	105	32
15	132	149	155	128	158	48
20	176	198	206	170	210	64
25	220	248	258	213	263	80
30	264	297	309	255	315	96
35	308	346	360	298	368	112
40	352	396	412	340	420	128
45	396	445	464	382	473	144
50	440	495	515	425	525	160
55	484	545	566	468	578	176
60	528	594	618	510	630	192
65	572	644	670	553	683	208
70	616	693	722	595	735	224
75	660	743	772	638	788	240
80	704	792	825	680	840	256
85	748	842	875	723	893	272
90	792	890	927	765	945	288
95	836	940	979	808	998	304
100	880	990	1030	850	1050	320
105	924	1040	1082	893	1102	336
110	968	1090	1134	935	1155	352
115	1012	1140	1186	978	1208	368
120	1056	1190	1238	1020	1261	384
125	1100	1240	1290	1063	1314	400

In the table above, the weight of baywood patterns is multiplied by 8.8 to obtain the weight of cast iron; by 9.9 for yellow brass; by 10.3 for gun metal; by 8.5 for zinc; by 10.5 for copper; and by 3.2 for aluminum castings. The figures in the table are to be used as a general guide only, because an appreciable difference in the specific gravity of different pieces of the same kind of wood is frequently found. When very accurate estimates are required, the specific gravity of the metal from which the casting is made must be ascertained, and the volume of the casting calculated with considerable care and accuracy.

Copyright, 1924, by The Industrial Press, New York

MACHINERY'S Data Sheet No. 39, New Series, August 1924 Contributed by L. H. George

MACHINERY'S DATA SHEETS Nos. 39 and 40

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, July 14

THERE is little change in the general industrial conditions in this country, the most noticeable feature being a degree of steadiness that has been absent since 1920 and suggests that more normal and stable conditions of business are not now so far ahead. The machine tool industry, which is inevitably the echo of the general condition of manufacturing industry, is in a distinctly hopeful state. In the Midlands, in particular, there is a good demand for most types of standard machines. Stocks are generally depleted, and in one or two important instances the full productive capacity of makers of turret lathes is sold well ahead. Makers of milling machines and threading machines are also much busier in the Midlands, the former having some large machines in hand for railway shops, while the latter are occupied on important contracts for railways and oil fields.

In the Yorkshire area, inquiry for radial drilling machines remains good, and lately there has been a much better demand for heavy machine tools for home and overseas railways. Generally these heavy machines are being equipped with individual motor drive.

Improvement is not so noticeable in the Manchester district. Grinding machines for railway shops are being ordered fairly freely, in recognition of the possibilities of grinding operations for a great deal of the work met with in locomotive building and repair. Precision grinding machines are also increasingly in demand, and the considerable growth in the use of grinding machines generally is reflected in the increasing business of firms who manufacture grinding wheels.

The machine tool industry in Scotland is more backward than in any other area, and not more than 50 per cent of the equipment available is actively employed. However, orders are said to have been coming in a little more freely of late, and the export market is responding, to some extent, to the attention bestowed upon it by British makers since home business fell off so heavily. There is a fair demand for radial drilling machines of the boiler shop type, and for lathes, but as there is a quantity of such machines on the second-hand market, orders for new tools are not easy to obtain.

At the annual meeting of the Machine Tool Trades Association, the president, Sir Alfred Herbert, announced that the bulk of the floor space at Olympia had been booked for the machine tool exhibition to be held next September, and there appears to be every prospect of a repetition of the success that attended the exhibition organized in 1920 by the association. This is considered to be very satisfactory, and the coincidence in time with the British Empire Exhibition is expected to result in a big attendance at Olympia of visitors from abroad who are directly interested in machine tools. The association is represented at the British Empire Exhibition at which the catalogues of the members of the association are available. During last year the scope of the association was enlarged to include woodworking machinery manufacturers.

Overseas Trade in Machine Tools

The exports of machine tools during May showed an advance over those for April, the tonnage increasing from 837 to 948, with corresponding values of £91,200 and £118,689. The export value per ton was £125, a distinct rise from the general average of £110 for the last six months.

Imports also increased, the tonnage rising from 243 for April to 294 for May, the corresponding values being £32,900 and £54,830. The value per ton of imports also showed an increase, the figure for May being £187, as against £136 for April. The value of small tools exported during May was £49,361.

During April, lathes were by far the most prominent among the exports, the total value being £38,256, of which India took £14,448 worth and France £8120 worth. Among April imports lathes were also the most prominent, the value being £7242, with America contributing £2919 worth, and Germany £2154 worth. America was the largest contributor of grinding machines, presses, and planing and shaping machines.

General Engineering Industries

Turning to other branches of engineering, the electrical industry as a whole continues to be well employed, and the makers of the innumerable small items classified under electrical apparatus are as busy as the builders of generating equipment. Railway car builders have sufficient orders in hand to keep them busy until the autumn, but new business is not coming in so fast as has been the case during the last few months.

Reports from different firms indicate that the textile machinery industry is steadily, though slowly, improving. Lancashire mill owners have, in some cases, been reconstructing recently, and have placed orders for new equipment, and some considerable foreign orders have also been received. The printing machinery industry is a bright spot, and the large firms engaged on this work have recently obtained some very satisfactory orders. Structural engineers are fairly well employed, and another branch of engineering that is busier than most others is that engaged in building sugar machinery.

The Automobile Industry

So far it cannot be said that the decision to drop in August the duties of 33 1/3 per cent on imported automobiles has resulted in a serious falling off in the demand for the small cars which have been such a feature of the recent activity of the industry. In any case, the full effects of the free imports cannot be judged until some months after the actual abolition of the duties, and it is felt that the rapid strides that have been made in the cutting down of manufacturing costs may replace some of the advantages formerly produced by the tariff. At the same time, there are very few who do not view the abolition of these duties as a severe handicap to an industry that is still in a stage of rapid development. Large batches of small cars are still being despatched to Australia and South Africa, and also to other markets where previously British cars have not found an easy access. The British bicycle trade has also during recent years gained an extensive hold on overseas trade, and this provides a practically continuous market winter and summer.

Sheet-metal stampings are being increasingly used by automobile, motorcycle and bicycle makers, in place of drop-forgings and malleable castings. Apart from the ultimate saving in manufacturing costs, a lighter and stronger product is generally the result. Several firms in this country are specializing in equipment for this class of work, and its development will undoubtedly play a big part in future competition in the industries mentioned.

Although on the Clyde a good deal of shipbuilding is still in progress, new orders are not coming in fast enough to maintain the present rate of building. Recent increases in labor costs have been a serious factor in this falling off.

Current Editorial Comment

in the Machine-Building and Kindred Industries

THE DESIGN OF AUTOMATIC MACHINERY

The series of articles on the design of automatic machinery now being published in MACHINERY deals with many difficult and unusual problems that face machine builders.

The most difficult problems in the design of automatic machines are not encountered in those intended exclusively for the cutting of metals. Machines for working other materials often require greater ingenuity than those employed in metal-working shops. Automatic machines are now employed in every manufacturing industry; but all are built in machine shops, and the machine designers are the creators or adapters of the ideas employed in their construction. Often such designers have gained their first experience on metal-working machines, and it is only by progressive experiments that they work out the modified mechanisms necessary in handling fiber, paper and other materials for the fabrication of which automatic machinery now is used.

As each material must be studied separately, the past experience of designers in different industries, recorded in the articles mentioned, will prove of great value to those who have similar problems to solve. Methods which work well with one material are impracticable with another. Vacuum cups, for example, are used effectively for paper, but cannot be employed successfully for porous materials; gravity feeds are suitable in some cases and not in others; shaking and rocking motions which will feed straight pins satisfactorily may not prevent clogging if bent shapes are to be fed from a hopper. A variety of methods, therefore, must be employed, and for the purpose of aiding the designer of automatic machinery for general industrial uses, these articles are published in MACHINERY.

* * *

WHEN TO USE TABLES OR DIAGRAMS

Practically all engineering information that can be presented in tabular form can be arranged also in the form of a diagram. Some engineers and machine designers have developed what may be called a "diagram habit," and use diagrams for recording in convenient form nearly all engineering data they wish to preserve for permanent reference. They prefer diagrams to tables, and devise diagrammatic expressions for everything that could be put in tabular form.

There is, however, a very distinct difference between the kind of information that can best be recorded in diagrams and in tabular form. When there are only a comparatively few dimensions or sizes, varying by definite intervals, a table is better than a diagram; for example, if it is desired to list dimensions of machine details that are made in a specified number of sizes, a table giving the necessary dimensions has every advantage over a diagram. On the other hand, when there is a large number of combinations of different factors, the diagram performs a service that a table cannot, unless it is made so large and elaborate as to be impracticable. For example, a diagram relating to the horsepower transmitted by gears of different pitches, widths of face, numbers of teeth, and running at different speeds, is entirely practicable; whereas a table giving all such possible combinations would fill a book.

In recording engineering data, sound judgment should be used in determining whether a table or a diagram best lends itself to the purpose. Whenever all the facts can be simply and easily recorded in a table, that method is generally best. If the variables are so many that a table becomes too voluminous, then the diagram will best fill the requirements.

Often diagrams are useful for visualizing a trend or tendency, because a curve will show this much more clearly than a set of figures. This, however, is a use for the diagram distinctly separate from that contemplated in the foregoing paragraphs, where tables and diagrams are used merely as convenient methods for recording information, and for obtaining unknown dimensions and sizes that depend upon, or correspond to, some known dimension.

* * *

STANDARDIZING MACHINE TOOL MOTORS

Machine tool builders often find it difficult to meet their customers' wishes in regard to the make and type of motor to be applied to machine tools, because of the variations in the dimensions of motors made by different electrical manufacturers, and to overcome this difficulty the National Machine Tool Builders' Association has requested the American Engineering Standards Committee to endeavor to bring about a degree of standardization of machine tool motors. It is proposed to standardize only such dimensions as would affect the application of the motors to machine tools; principally the location of bolt holes, base pads and the maximum width and height, so that the motors will be interchangeable when applied to the same service.

It is said that the German electric motor manufacturers have adopted standard motor dimensions, but whether this is true or not, American manufacturers will doubtless meet any reasonable requirements, as it is to their advantage to do.

As there are comparatively few American electric motor manufacturers, it should be possible for them to arrive at some mutually satisfactory standard dimensions without much difficulty. The dimensions are of no particular importance to the machine tool builder, so long as they are uniform; and if the leading electric motor manufacturers will agree upon standard dimensions, others will doubtless adopt them also.

* * *

MACHINE TOOL LUBRICATION

The continuous operation of machine tools in shops engaged in mass production has focussed attention upon a new problem in machine tool design. Formerly, comparatively simple means for lubricating the bearings were effective; now, in machines continuously operated for long periods, more highly developed lubrication systems are required. In the automotive industry the demand is for automatic or forced lubrication. Several machine tool builders have introduced this feature in their designs, but users of machine tools are demanding a still more general application of mechanical lubrication. In some machine tools the lubricating methods are not essentially different from those in use twenty years ago, and improvements in lubrication would increase their productive capacity by averting bearing troubles and shut-downs for repairs. The comparatively inexperienced operators in modern mass-production plants do not give sufficient attention to the lubrication of hand-oiled machines, and some method of "fool-proof" automatic lubrication is necessary. Machine tool builders who have already incorporated such systems find them helpful in obtaining repeat orders, because their machines get a reputation for standing up when subjected to severe service.

Encouraging Suggestions from Your Men

By K. C. MONROE, Bridgeport Brass Co., Bridgeport, Conn.

MEN in the shop who work day after day on a given job frequently evolve ways of doing their work and the jobs of their fellow employes with less effort or at increased speed. However, the ideas are usually kept to themselves, because there is no inducement to pass them along. The Bridgeport Brass Co., Bridgeport, Conn., supplies an incentive to the workmen to submit new ideas by paying them a fair sum of money for each idea that is found by the economies committee to be worth putting into effect. The plan has been in satisfactory operation for about five years in both plants of the company.

The Committee that Makes the Awards

Each department has a supply of blanks on which anyone may make suggestions. They may be mailed to the chairman or secretary of the economies committee or simply deposited in a box near the main factory gate, where they are collected by the secretary. The committee consists of ten members, five of whom are representatives elected by the employes at annual elections, while the remaining five are appointed by the management.

The secretary of the economies committee reads all suggestions and writes a letter of acknowledgement to each sender. He then has a number of copies made on which the name of the suggester is left off, and forwards these copies to those who, in his opinion, are best qualified to investigate the idea and report on it. Thus the investigations are carried on without knowledge as to the originator of the suggestion, and to this particular point the success of the system is largely attributed.

The economies committee holds two meetings every month at which all suggestions and reports on the investigations are read by the secretary and discussed by the committee. Then a vote is taken to determine whether the suggestion is to be accepted, rejected, or investigated further. If doubt exists as to whether or not it would result in real economy, the committee has the power to have the suggestion put into effect temporarily to determine just how much money would be saved by adopting it. This is often done with suggestions pertaining to machine attachments and tooling intended to speed up production without requiring additional labor. At no time during the discussion at the committee meeting or during any further investigation or trial of the suggestion is the name of the suggester known to any other person than the secretary of the committee, the name being given to the committee only after the vote has been taken to accept or reject the idea.

Awards for Ideas Accepted

The committee has the power to award from $5 to $25 for each suggestion accepted. As a matter of policy, an order for payment of an award must bear the signature of an officer of the company. If for any reason it appears to the management that the committee did not act with the proper judgment in passing on a suggestion, the payment of the award is held up until after the next meeting of the committee at which time the suggestion is discussed in detail. During the last year there were only three differences in opinion between the management and the economies committees of both plants, in making a total of sixty-one awards. Such differences as existed were settled to the satisfaction of all concerned.

In determining the amount of the award, the committee naturally takes into consideration the economy that will result from carrying out the suggestion. If, in the opinion of the committee, the award should be more than $25, a formal recommendation is made to the management to this effect, outlining in detail the points that are worthy of special consideration. Larger awards than the maximum mentioned have been made in a number of cases, and in one instance where a workman made complete drawings of a machine, the award was $250.

To stimulate the submitting of ideas, a special award of $25 is made to any man who has had five suggestions accepted. This award is paid after the fifth suggestion is found worthwhile, no matter how much time has elapsed since the previous ones were accepted. All awards are paid in cash by the secretary of the committee, and each one is accompanied by a letter from the general works manager congratulating the suggester upon the acceptance of his idea and encouraging him to send in others.

Employes Eligible for Awards

Any employe below the rank of superintendent may make suggestions, except for a certain class of workers. For instance in all factory organizations there are employes whose work consists of determining ways and means of reducing costs, and obviously no award should be paid to employes of this class. Foremen may submit suggestions, but are only eligible for an award in case their ideas could not be carried out by them without executive approval.

It is the duty of the secretary to notify the suggester when it is decided by the committee to conduct extensive investigations before making a decision concerning the award. This is in order that the man may know that consideration is being given to his suggestion; otherwise he may think that it has been overlooked. When a suggestion is rejected, the secretary writes a letter to the man explaining in detail, in a diplomatic manner, the reasons for rejection. It is the duty of the secretary to make sure, by personal contact if necessary, that no feeling of injustice results from the action of the committee. Failure to do this is responsible for the downfall of the suggestion system of many concerns. If an employe feels that he has not been treated properly, he will not only stop sending in suggestions, but will influence other employes against doing so.

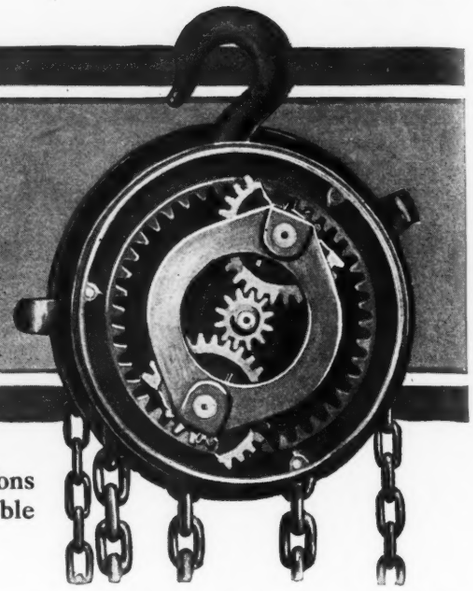
When this system was first started, notices were posted on all bulletin boards describing the system and urging employes to send in suggestions. At first a large number of suggestions were received, many of which would not have resulted in economy if carried out, and some of which would have required such heavy expenditures for equipment that a number of years would have elapsed before the savings would balance the investment. Consequently only a small percentage of the suggestions was accepted. However, as time went on fewer suggestions were made, but they contained better ideas. The average acceptance for the first five years was approximately 30 per cent, but for the last two years the average has been 45 per cent, which is considered a good record. In the last two years 351 suggestions have been received.

* * *

The American Institute of the City of New York announces that an exposition of inventions will be held December 8 to 13 in the Engineering Societies' Building, New York City. The exposition will be handled by the institute, and arrangements for the display of working models or actual devices may be made by addressing the Exposition Committee of the American Institute of the City of New York, 47 W. 34th St., New York City. All proposed displays are subject to the approval of the institute.

Planetary Gearing

By FRANKLIN DeRONDE FURMAN
Professor of Mechanism and Machine Design
at Stevens Institute of Technology



Beginning of a Complete Treatise on the Simplified Solutions of Various Planetary Gear Problems, Including a Reliable Graphical Method of Checking Calculations

PLANETARY gearing, or epicyclic gearing as it is also widely known, is a branch of the general subject of mechanism that is much more used and far more useful than is generally supposed. The lack of general information on this unique branch of mechanism is probably due in part to the fact that no attempt has ever been made to deal thoroughly with the subject. Perhaps this is because of the fact that solutions of original problems in planetary gearing are by far the most elusive, even to the initiated, of all the problems in the several branches of machine design. That this should be so is all the more curious because there is no group of machine problems that may be solved with so little arithmetical work and with so little drudgery in computation work. Problems covering the entire subject of planetary gearing, even when apparently complicated, have amazingly short mathematical solutions. These solutions are almost entirely accomplished by mental processes that must be both concentrated and acute, and for these processes there can be no substitute when mathematical formulas alone are involved. The mental process once completed, the arithmetical solution is soon set down. But here, again, those who have great faith in their ability to analyze correctly, will doubtless often own to a lingering doubt as to the accuracy of the result obtained in an original problem until it has been constructed and tried, or until it has been otherwise proved. For it must be remembered that planetary gearing is the subject in which there are "wheels within wheels," and that phrase is commonly used to symbolize mystery as to truth in practical affairs.

With a full appreciation of the undeveloped theory underlying the subject of planetary gearing as a whole, the writer has endeavored to add such substance and body to that theory as will serve as a substantial and sure foundation on which one can work with certainty throughout the entire range of the subject of planetary gearing. Even after much study and time had been given to the work, final success, so far as positive certainty of results was concerned, seemed as far off as ever, even though a formula, not original in general form, had been adopted and used with an original method of analysis and application behind it. What was wanted was a totally independent method of proving results that would not involve the time and costs necessary to the actual construction of models. This was ultimately found in the principle of the instantaneous center, which can be practically applied in all possible cases by anyone who can visualize, usually with the aid of a skeleton sketch, the mechanism involved and the motion each piece has at the instant the parts begin to move from any stationary position.

The process of solution here involved in this independent method of checking arithmetical results is entirely graphical. It is extremely simple and does not require a study of the general principles of mechanism or of velocity diagrams, except in some few cases where short cuts might be used, particularly in compound planetary mechanisms. This graphical solution, being entirely independent of the arithmetical solution, serves as a certain check on the latter method. Furthermore the graphical method consists in laying down the several velocities of the moving parts, one at a time, in their logical order, without recourse to the involved mental process required in arithmetical solution.

That planetary gearing is not an abstract subject and one for which there is little use can best be evidenced by a brief recital of the many branches of industry in which this form of gearing is already used, and of other applications that could and would be made if it were better and more generally understood. Without attempting to give an extensive list of its application, one may readily recall its use in such mechanisms as the transmission gear, the differential gear, and the steering wheel gear of automobile mechanism; in machinery for manufacturing wire rope and manila rope; in transmission dynamometers and water wheel governors; in slow-feed boring-bars, and other machine tool parts; in mowing machines and battle tank transmission; in capstans and reverse gears, particularly in marine mechanism; in steam turbine and electrical machinery; in speed-reduction devices and speed-variation detector devices for multiple driving units; in watch construction; in bolt threading machinery; and in pneumatic drill and hoisting mechanisms.

This general subject will now be dealt with in a more specific manner, starting with a brief definition of planetary gearing, the detailed illustration of a simple planetary mechanism, a statement of the notation to be used throughout the series, and an outline of the graphical and arithmetical methods to be used in all problems, with a practical problem worked out by these methods.

Planetary gearing is the common name for a special type of mechanism

This article is the first of an extensive series covering the entire subject of planetary gearing. The author has developed in a simple manner the fundamentals of this subject and presents an analysis of planetary gear problems that is basic and general in its application. The original graphical method used throughout may be employed in quickly checking results obtained by the analytical method, which is recommended for general use. Many examples will be included to show how the different methods of solution are applied, both to the common as well as the unusual problems.

used in the transmission of mechanical motion. It is composed of a series of mounted toothed wheels in gear, the distinctive characteristic being that some of the wheels turn on movable centers, while the others turn on fixed centers. Its specific advantage is that it may give very little or very great change in angular velocity with the same or the opposite directional relation, all within very small compass. Usually the change in angular velocity is in the nature of a reduction, and a ratio of one turn of a follower wheel for 1000 turns of a driver wheel is readily obtained. The wheels that turn on movable centers are termed "planet wheels" and those that turn on fixed centers are called "sun wheels."

In Fig. 1 the wheels E and L are planet wheels turning on the pins B and J, respectively. These pins are mounted in the "train arm" H which is keyed to the shaft M. The wheels C and F are "sun wheels" whose axes are at O. One of the sun wheels is usually a fixed (non-rotating) wheel, and in this illustration F is the fixed wheel. With the sizes shown in Fig. 1, if the crank arm R is the driver and if it is turned three times, the follower shaft M will turn once in the same direction as the driver.

"Epicyclic gearing" and "epicyclic trains" are terms frequently used for this type of gearing, because of the fact that the pitch circle of planet wheel E corresponds to the epicycle which is technically a circle whose center moves in the path of another circle T called the deferent. If the epicycle is considered as a "generating" circle rolling on its "fundamental" circle U of radius OP, any point such as V on the epicycle will trace the path of an epicycloid, Y; likewise, if the epicycle rolls internally on a "fundamental" circle whose radius is OQ, the point V on the epicycle will trace the hypocycloid Z. Inasmuch as the epicyclic and hypocyclic paths Y and Z are not used in any way in this class of gearing, it does not seem appropriate to use the term "epicyclic gearing." On the other hand, the term "planetary gearing" instantly conveys the idea involved and differentiates this type of gearing from the ordinary type in which the wheels have fixed centers.

Three Methods of Solving Planetary Gear Problems

Problems in planetary gearing generally seem more difficult than problems in any other class of mechanism, and this is due quite naturally to the fact that there is a combination of rotation and revolution and circular translation which is not easily followed by the mind throughout the complete cycles of the several motions. Furthermore the motion of circular translation, which will be described further on, is not generally understood; consequently, to solve problems in planetary gearing with certainty, some definite method of procedure must be adopted that will apply in all cases and this method must be rigidly adhered to. In addition, it is always advisable to check the results obtained in each problem by a second or different method. In this series three different methods will be used as follows: (1) the graphical method; (2) the geometrical method; and (3) the analytical method.

The third or analytical method is recommended for general use, because it gives exact results, and requires only a simple formula and little or no sketching. If a sketch is used, it may be drawn freehand and quickly made because it need not be drawn to scale. The first or graphical method necessitates drawing to scale, and is used to advantage in quickly checking the analytical method. The first method should be used as a check only, for the results obtained by it are not sufficiently accurate for many practical purposes. The second or geometrical method requires the same constructions as the graphical method, but in the second method the drawing may be made freehand and not to scale. This method requires more computation work than the first or third method, but it gives exact results.

The notation that will be used throughout this series of articles is as follows:

N = number of turns of driver to one of the follower or driven member;
N' = number of turns of follower to one of driver;
N_1 = number of turns of driver to one complete revolution of planet wheel axis;
N_2 = number of turns of follower to one complete revolution of planet wheel axis;
D = diameter of pitch circle of driver, if driver is a toothed wheel; (The driver, or the follower, may be the "train arm," and not one of the toothed wheels, according to the data of a problem.)
D_1 = diameter of pitch circle of follower, if follower is a toothed wheel;
D_2 = diameter of pitch circle of fixed wheel;
D_3, D_4, etc. = diameters of pitch circles of planetary wheels;
T = number of teeth in driver, if driver is a toothed wheel;
T_1 = number of teeth in follower, if follower is a toothed wheel;
T_2 = number of teeth in fixed wheel; and
T_3, T_4, etc. = number of teeth in planetary wheels.

In the study of planetary gearing where assumed data are used for exercise problems, it is more convenient to work with the diameters of the pitch circles of the gear wheels; and where planetary gears have already been constructed and are to be solved, it is more convenient to work with the numbers of teeth in the wheels. Since the numbers of teeth in any mating pair of gear wheels are always in the same proportion as the diameters of the pitch circles of the wheels, identical results will follow from a proper use of either D or T in the formulas used in the analytical method. In solving problems by the graphical or geometrical methods, where T is used, it is necessary to go through an additional step when the circular pitch on *all* gear wheels is not the same. This will be illustrated in a later problem.

Answers to the problems in the elementary part of this treatise will, in general, be given in terms of number of revolutions of driver per one revolution of the follower. Then, according to the notation just given, it follows that all such problems should have the final answer in terms of N. It is particularly important to keep in mind, in this connection, that it is the one revolution of the *follower or driven shaft* that becomes the *unit of measurement* of the relative velocities of driver and follower shafts in these elementary planetary gear problems; and,

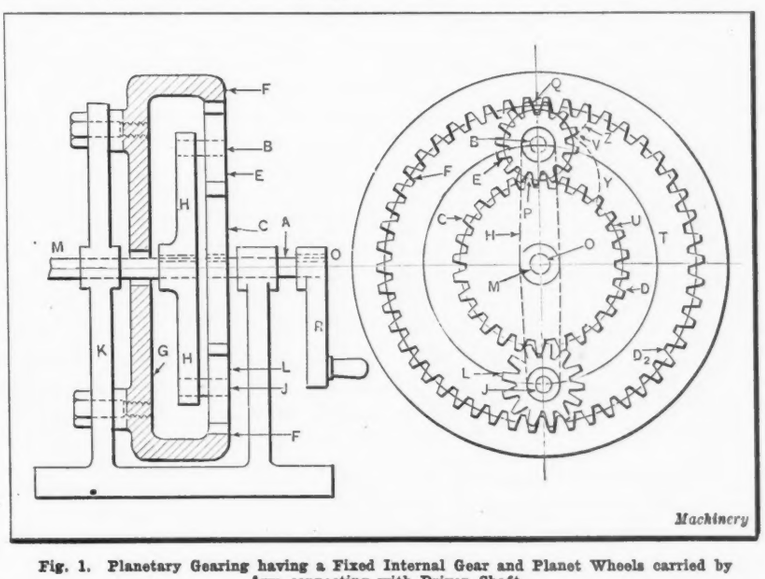


Fig. 1. Planetary Gearing having a Fixed Internal Gear and Planet Wheels carried by Arm connecting with Driven Shaft

also, that it is one revolution of the *train arm*, or planet wheel axis, that is the *basis for the solution* of problems by the analytical method.

Basic Features of Planetary Gearing

In the mechanical construction of planetary gear mechanisms, there are three possible basic structural arrangements, as follows:

1. The train arm, which carries the planet wheel pins, may be keyed to the follower shaft, as in Fig. 1. In this case, then, the train arm and the follower shaft each make one revolution in the same time, and according to the notation, $N = N_1$. Problems relating to this structural type will be classed in the early problems in Group 1.

2. The train arm may be keyed to the driver shaft. In this case, since the revolution of the train arm is the basis for the solution, it will be necessary at first to find the number of turns of the follower shaft to one of the planet wheel axis. This, according to our notation, is N_2. Since the train arm is keyed to the driver shaft, the answer for N_2 will be in turns of follower to one of driver, which is the inverse of the adopted way of giving the answer. Therefore $N = \frac{1}{N_2}$ when the train arm is keyed to the driver shaft. Problems relating to this structural type will be classed in Group 2.

3. The train arm may run as an idler on a central shaft without being keyed to either the driver or follower shafts. In this case, the analytical method of solution requires, first, that the number of turns of the driver to one of the train arm be found. This gives N_1, according to the notation. Second, the number of turns of the follower to one of the train arm must be found, or N_2. Then, knowing the number of turns of both driver and follower in the time required for the train arm to turn once, it follows that $N = \frac{N_1}{N_2}$. Problems relating to this structural type will be classed in Group 3.

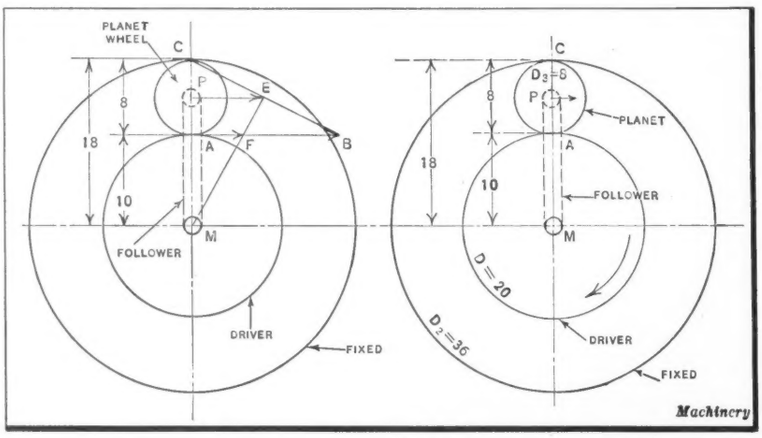


Fig. 2. Application of Graphical Method—Problem 1

Fig. 3. Essential Data for Mathematical Solution—Problem 1

Problems in Group 1, in which the Train Arm is Keyed to the Follower

The train arm is always keyed to the follower shaft in this group; hence the computation is made directly for N. The first of these problems will be solved by each of the three methods, although later on the first and third methods only will be used unless otherwise specified. In the representation of all problems in all groups, only the pitch circles of the toothed wheels will be represented, as the drawing of the tooth outlines, as shown in Fig. 1 is entirely unnecessary in the analysis and the solution. It is to be kept in mind that the pitch circles are in pure rolling action all the time; that is, there is no slippage of the pitch circles. At the point of tangency they are at rest relative to each other at any phase or instant.

Problem 1—Given a driving wheel with a pitch circle diameter of 20 inches, a fixed internal wheel with a diameter of 36 inches, and a planet wheel with a diameter of 8 inches. Find the number of revolutions of driver shaft to one of the follower shaft. The train arm is keyed to the follower shaft in this problem. Then, according to the notation:

$D = 20$, $D_2 = 36$ (internal), $D_3 = 8$. Find N.

Solution of Problem 1 by Graphical Method

Lay out accurately to scale, as in Fig. 2, the diagrammatic circles and lines representing the gear. MA is the radius of the pitch circle of the driving wheel and is equal to 10 inches; AC is the diameter of the planet wheel, equal to 8 inches; MC is the radius of the fixed wheel, equal to 18 inches; and MP is the train arm which carries the planet wheel pin. From point A on the pitch circle of the driving wheel, draw the line AB of any convenient length. This line represents the tangential linear velocity of point A of the driving pitch circle. Since there is pure rolling (no sliding) between the pitch circles of the planet wheel and the driving wheel at A, the distance AB must also represent the linear velocity of point A of the planet wheel.

Point C of the planet wheel is momentarily at rest, because there can be no sliding between the planet wheel and the fixed wheel. Consequently, every point in the planet wheel is turning about C with a velocity proportional to its distance from C, and point P of the planet wheel has the linear velocity PE, found by drawing the line BC.

Point P on the train arm MP coincides with point P on the planet wheel, and has the same motion; therefore, the linear velocity of point P on the follower train arm is also PE, and the linear velocity of point A on the train arm is AF, found by drawing EM. Since the linear velocity of A of the driver is AB and the linear velocity of point A of the follower arm is AF, and since these two linear velocities are at the same radial distance, they become relative measures of the angular velocities. If, for example, AB is now considered to represent 800 revolutions per minute, and AF represents 280 revolutions per minute, as nearly as can be determined by measuring both to the same scale, then N, which is the number of revolutions of driver to one of the follower, would be

$$\frac{AB}{AF} = \frac{800}{280} = 2\ 6/7$$

which is approximately correct. As AB and AF are both in the same direction, the driver and follower shafts will both turn in the same direction.

It will be noted that while this first method is exact in principle, it is only approximately so in practice, for it depends on absolute precision of drafting and scale reading. Since any error in planetary gearing problems is increased by the amount of the error during each succeeding cycle, the smallest error will soon grow to a large one. This first method, however, has the advantage that it may be easily reasoned out and applied when the other two methods, especially the third, cannot be recalled. In general, the results obtained in solving planetary gear problems should be given in common fractions rather than in decimal fractions.

Solution of Problem 1 by Geometrical Method

In the geometrical method, a free-hand sketch, not to any definite scale, but approximately representing the sizes in the problem, must be drawn and the velocity lines placed on it as described for the graphical method. The free-hand sketch will then resemble the illustration Fig. 2, except that the lines will be less accurate.

From the graphical method it was shown that $N = \frac{AB}{AF}$.

In Fig. 2 there are two sets of similar triangles, one set being CAB and CPE, and the other MPE and MAF. In the first pair of similar triangles $\frac{AB}{PE} = \frac{AC}{PC}$, and in the second pair $\frac{PE}{AF} = \frac{PM}{AM}$. Combining these equations, $\frac{AB}{AF} = \frac{AC \times PM}{PC \times AM}$. Substituting the values given, $AC = 8$, $PM = 14$, $PC = 4$ and $AM = 10$, we have $N = \frac{AB}{AF} = \frac{8 \times 14}{4 \times 10} = 2\ 4/5$. From this it is determined that it will take 2 4/5 turns of the driver to produce one turn of the follower, both turning in the same direction.

Solution of Problem 1 by Analytical Method

In the analytical method, the "reading" of a standard formula with or without the aid of a sketch is all that is depended on in the solution of a problem. The standard formula is mathematically deduced as follows: In the demonstration of the geometrical method, it was shown that $N = \frac{AC \times PM}{PC \times AM}$. It will be noted that all the items in the second half of this equation are in terms of the radii of the several wheels. Letting R represent the radius, $D = 2R$, $D_2 = 2R_2$ and $D_3 = 2R_3$. Then $AC = 2R_3$ (see Fig. 2); $PM = R + R_3$; $PC = R_3$ and $AM = R$. Therefore, the preceding equation for N may be rewritten as follows:

$$N = \frac{2R_3 \times (R + R_3)}{R_3 \times R} = \frac{2R_3R + 2R_3^2}{R_3R} = \frac{R + (R + 2R_3)}{R} = \frac{R + R_2}{R}$$

$$N = 1 + \frac{R_2}{R} \qquad (1) \qquad\qquad N = 1 + \frac{D_2}{D} \qquad (2)$$

$$N = 1 + \frac{D_2}{D_3} \times \frac{D_3}{D} \qquad (3)$$

The reason for carrying this arithmetical development through the simpler stages to the final form given, is that in this latter form the motions of the several wheels in the planetary gear mechanism can be readily visualized and the values of these motions can be substituted in the formula, enabling one to make a quick and accurate solution of the problem.

Developing Formula from Analysis of Gear Action

It will be recalled that the basic mechanical element in the analytical method is the planet wheel axis or pin located at the point P in Fig. 3. The time required for this pin to turn through 360 degrees, about M as a center, is taken as the time unit in all cases, and the number of turns made by the driver and by the follower in the same time are determined and compared. This is the fundamental principle of solution of problems by the analytical method. In applying this principle, consider that all the parts of the planetary gear device shown in Fig. 3 are securely locked, and that the whole device is rotated once in a *clockwise* direction about M. Then the planet wheel pin P will be turned through 360 degrees about M and the driver wheel and the follower arm will also be rotated the same amount. Putting this in a formula we may now write $N = 1$.

Remembering that all the wheels were locked in the last operation, it becomes evident that the fixed wheel D_2 has also had one full turn clockwise, although in the actual working of the gear it is fixed; therefore, the fixed wheel only must now be turned back one full turn in a *counter-clockwise* direction while the planet wheel pin and the train arm remain stationary. In turning back the fixed wheel, the planet wheel D_3, which is in gear with the fixed wheel, will be turned counter-clockwise, and the driver will be turned clockwise thus receiving additional motion to that which it received by the operation described in the preceding paragraph. This additional motion is also clockwise; hence the second step in writing the standard formula is to place the direction sign in it, plus (+) indicating clockwise rotation and minus (—) counter-clockwise rotation. Then the formula as thus far developed will be written $N = 1+$.

The third step in writing the standard formula is to determine how much the driver D is turned in a plus direction while the fixed wheel D_2 is being turned back one full turn. This is readily noted by observing the number of turns that D_3 will make while D_2 makes one turn, and also the number of turns that D will make while D_3 makes one turn, and then multiplying these together. For example, D_3 will make as many turns as the number of times that the circumference of D_3 is contained in the circumference of D_2. This is expressed by the fraction $\frac{D_2}{D_3}$. Likewise D will make a number of turns, or a fraction of a turn, depending on the number of times that its circumference is contained in that of D_3. This is expressed by the fraction $\frac{D_3}{D}$. Summing up this third step, the wheel D will turn $\frac{D_2}{D_3} \times \frac{D_3}{D}$ times while the fixed wheel is being brought back one full turn. Adding this motion to that already determined by the first two steps in this analysis of the standard formula, we have

$$N = 1 + \frac{D_2}{D_3} \times \frac{D_3}{D} \qquad (4)$$

This formula is the same as Formula (3) which was developed analytically. Having thus produced, from a study of the action of the gear, the formula that will solve the problem, it is only necessary now to substitute the figures given in the problem. Then:

$$N = 1 + \frac{36}{8} \times \frac{8}{20} = 2\ 4/5$$

All problems in planetary gearing may be solved by the simple use, or by a combined, or modified use, of the standard type of formula (4), in conjunction with a sketch of the essentials of the gear, as shown in Fig. 3. In giving the data for problems, especially where four or more gear wheels are involved, it may happen, with certain combinations of sizes, that the wheels may go together in two different ways, depending on whether all the wheels are external, or one of them internal. Therefore, to make all problems definite, the data should indicate which wheel or wheels are internal if there are any. When a certain number of gear wheels are given as constituting a planetary gear, it is the number that are necessary for kinematic action only that is meant, and not the number that are necessary to produce the desired strength. For example, in Fig. 1, the three wheels C, E, and F are the essential ones, kinematically, and they are the only ones used in solving the problems. The additional wheel L serves to balance and to give strength to the mechanism, but does not affect its kinematic solution. Instead of one gear wheel as at L, there are often one or two more mounted on suitable train arms or in a train disk.

* * *

A special research bureau of metallurgy, to begin its work in September, has been inaugurated by the Carnegie Institute of Technology in Pittsburg. The object of the new department will be to apply to metallurgical questions the recent discoveries in the field of physics and chemistry. The new bureau will be conducted separately from the research investigations carried out by the department of metallurgical and mining engineering in cooperation with the Bureau of Mines.

What Our Readers Think

on Subjects of General Interest in the Mechanical Field

THE COST OF DOING WITHOUT GOOD MACHINE TOOLS

I have read with interest many of the editorials that have appeared in MACHINERY on the need for replacing old machine tools with new equipment. As a machine tool salesman, I have for many years used the slogan that it costs more to do without good equipment than to buy it. I have made many sales by demonstrating that fact, and it is the only argument by which any machine tool really should be sold. The value of a machine tool to the user does not depend upon the price of the machine, but upon the savings possible through its use. The long life of machine tools spreads the investment over many years; the difference in first cost between different machine tools, therefore, becomes of little importance, provided one machine has greater productive capacity than another, for the better machine will then bring in profits year after year until, as is always the case in the machine tool field, new and improved equipment is brought out which takes the place of the old. Let every machine tool user thoroughly consider the fact that it always costs more to do without good equipment than to buy it.

C. L. W.

EFFICIENT INSPECTION MANAGEMENT

Out of twenty applicants for a position as floor inspector who offered their services in reply to an advertisement, only six were found to have had actual experience as inspectors. One by one these six men were sent to the chief inspector to be interviewed. Their experience had been gained in plants located in manufacturing centers of the Middle West, and without exception each of the six applicants put particular stress on the fact that he had been "final inspector" or in charge of "final inspection" at a certain plant.

The fact that these inspectors in every case represented themselves as experienced men in "final inspection work" indicates that they had discovered that it paid best to go after that grade of job, and that this practice of grading inspectors is a prevalent one. In fact, in the particular plant referred to, the chief inspector was handicapped by this condition. The schedule of rates on file with the employment department specified a starting and a maximum wage for final inspectors which was ten cents an hour higher than for floor inspectors. Passing over any consideration of the quality of the men secured by the higher rate, it goes without saying that skilled men could hardly be expected to be satisfied with their positions as floor inspectors when higher wages are paid to the final inspectors. A readjustment of this schedule, however, could only be secured by convincing the plant manager of the drawbacks of the existing system of grading and of the ultimate economy and improvement in quality of the product that could be expected to follow a more consistent rating of the skilled inspectors.

This would, of course, require a general reorganization of the inspection department. It should be obvious that any system of inspection in which men of ordinary skill are employed in checking up the various operations in the shop, while highly skilled inspectors pass upon the completed product, is fundamentally wrong and is not accomplishing what the same skill would accomplish if differently applied. In principle, it is the same old losing game of hiring an expert locksmith to bar the stable door after a careless watchman has allowed the horse to be stolen. Inspection, when considered from the standpoint of its economic possibilities, is something more than standing idly by and watching a workman spoil a piece of work and then telling him it is spoiled after it is too late to repair the damage. It should involve an analysis of machining methods, as well as the results obtained, and this analysis should be made a factor in preventing spoiled work.

The best results can be obtained only by applying the maximum mechanical skill at the source of production. Experienced men on the shop floor can detect errors or inaccurate work before many pieces have been spoiled; and they can take steps to eliminate further spoilage. Thus it would seem only logical that the highest grade of inspectors should be positioned at the strategic points in the production department. The most skillful and presumably the highest paid men should, therefore, be the floor inspectors. These men should work in close cooperation with the department foremen. The ability of such men should not be measured by the size of the scrap heap they can pile up, but should be gaged by the degree of success they and the foremen working together can attain in holding down the size of the scrap heap.

Referring to the so-called "final inspection," the writer believes that in most cases this does not necessarily demand a high degree of mechanical skill. It simply involves checking the work by established standards over which the inspector has no control. If a part measures up to the standards, it is accepted, and if it does not, it is rejected. In many cases, intelligent and conscientious men without any great amount of mechanical experience can handle this work successfully.

P. H. BRYANT

THE CHANGING OF STANDARD TERMS

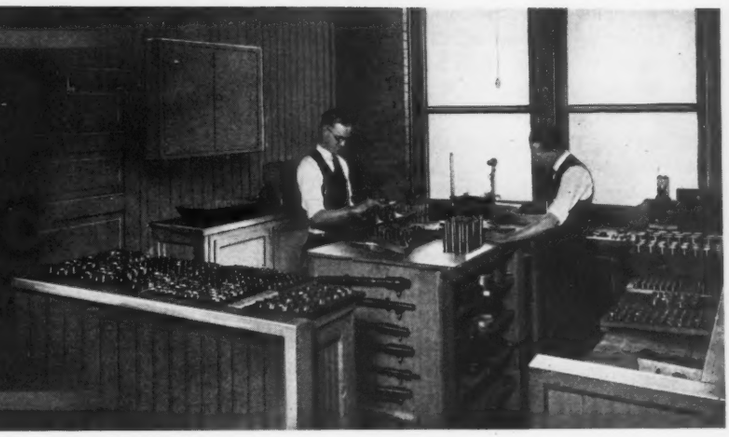
The writer views one of the tendencies in the present standardization work with some apprehension. No one will deny the great value of standardization in the industries, because it eliminates waste, speeds up, simplifies, and cheapens production, and increases prosperity; but sometimes it seems as though unnecessary changes are made in the name of uniformity and standardization. This thought is particularly brought to the writer's mind by the change in name proposed for our standard system of screw threads.

For over fifty years the thread system originally developed by William Sellers has been known as the United States Standard thread. At the present time it is proposed to change, not the system, but the name, calling it either the National Standard thread or the American Standard thread. It seems unwise to change the designation of a thread system that has been so thoroughly established as a standard, and that is known by the designation United States standard thread all over the world.

The word "National" is especially objectionable because, while this term may have a significance in this country, it is not a definite, descriptive term when used internationally. If the words National Standard screw thread are used in England, for example, it would be quite reasonable for a British engineer to assume that the British or Whitworth screw thread is referred to. In this respect the term "American" is preferable; but why change the words "United States" to "American" in connection with a screw thread that has been known by the former name for more than half a century? Thoroughly established names, the meaning of which is perfectly clear and the use of which cannot lead to confusion, should be left alone.

A. E.

Manufacturing Interchangeable Counterbores



Unusual Operations and Fixtures Employed in Making Counterbores and Holders

By CHARLES O. HERB

WHEN an article has been invented and patented, success is not necessarily within sight; often the hardest problem to be solved is how to manufacture the article by methods that will be sufficiently economical to permit it to be sold at a competitive price. The founder of the Gairing Tool Co., Inc., Detroit, Mich., has been a pioneer in the development of modern interchangeable counterbores and holds patents for several designs. For the exclusive manufacture of these cutters and their holders on a quantity production basis (from 16,000 to 20,000 counterbores and about 500 holders being produced per month), the company had to work out a number of interesting methods which will be described in this article. The counterbores and holders are carried in stock for immediate delivery in a complete range of sizes from ¼ to 3 inches in diameter, larger cutters up to 5 inches in diameter being made special.

"Hexing" the Cutter Shanks

These counterbores and holders are designated as types A, B and C. Type A was described in March MACHINERY, type B in January, 1920, MACHINERY and type C in July MACHINERY. Type A five- and three-flute cutters are illustrated in Fig. 3. This type is driven by means of the hexagonal section *A*, which engages a corresponding recess in the holder. The cutter is attached to the holder by means of a pilot with a threaded shank which is inserted through the hole in the counterbore and screwed into a nut in the holder. It will be noted that the cutting edges are slightly in advance of lines radiating from the center of the counterbore but parallel to these radial lines. A fixture designed for use in the operation of "hexing" portion *A* of the counterbores will be described first.

When the counterbores come to the "hexing" machine, which is illustrated in Fig. 1, they are simply blanks turned down at one end to suit this operation and drilled through the center. The blanks are held one at a time in the fixture with the shank uppermost, and straddle milling cutters are employed for the operation. After two sides have been milled, the counterbore is indexed 30 degrees for milling two more sides, and then another 30 degrees for completing the operation. Lubricant is supplied copiously in this and most of the other operations on the counterbores because they are made from high-speed steel.

The construction of the fixture will be more clearly understood from the line illustration Fig. 6. It will be seen that there are three jaws *A*, supported by the threaded chuck

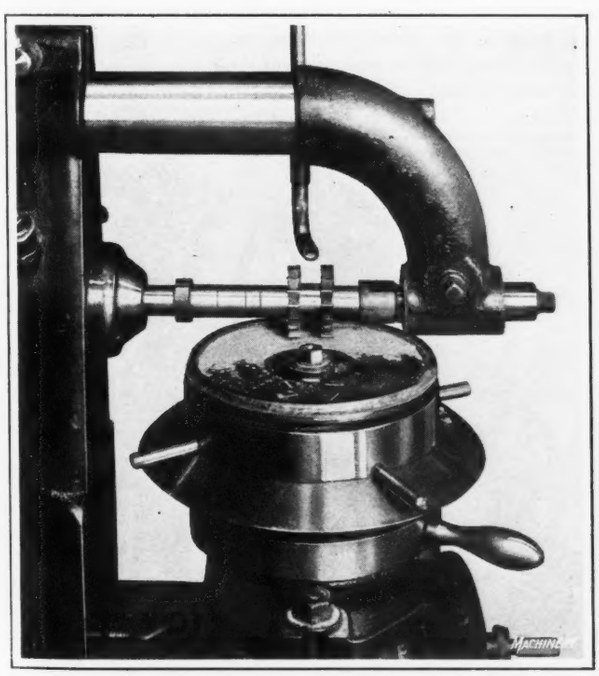


Fig. 1. Special Indexing Fixture used in "hexing" Type A Counterbores

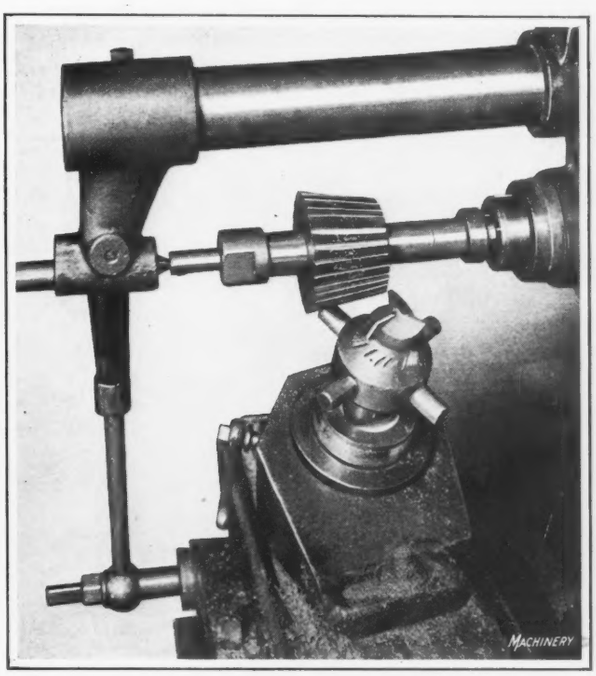


Fig. 2. Fixture used in gashing out the Metal in back of the Cutting Edges

ring *B*. The jaws are closed on the work by rotating the ring nut *C* which engages the thread of ring *B* and which has an internal conical surface that acts on the wedge-shaped ends of the jaws when the nut is tightened. A small coil spring in each jaw forces it from the work as the nut is loosened. After the jaws have been tightened on a piece, parts *A*, *B*, and *C* are held together as one unit for indexing. They are rotated on base *D* during the indexing, but are clamped tight to it for each milling step by ring *E*, which engages threads on base *D*.

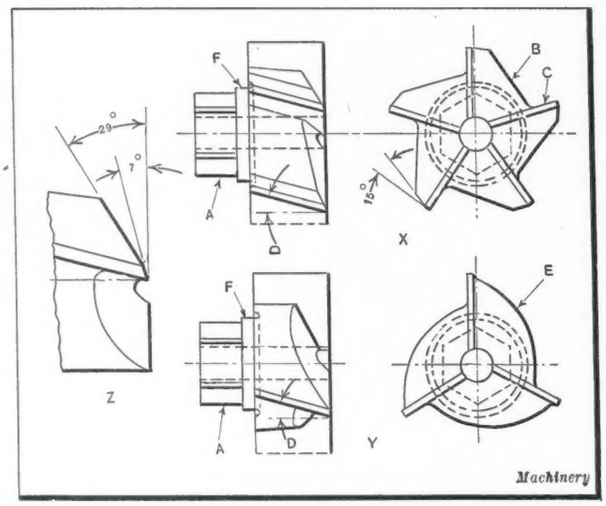


Fig. 3. Three- and Five-flute Counterbores

Ring *E* is rotated in order to loosen it from ring *B*, by swinging handle *F* to the right. When the ring has been rotated a certain amount, pawl *G* withdraws plunger *H* from one of the six slots that are spaced equidistantly around ring *B*. These slots and the plunger provide a means of locking the fixture in six positions. As plunger *H* is released, pawl *I*, which is also attached to ring *E*, engages another one of the slots in ring *B*, as shown at *X*, and then as handle *F* is further pushed to the right, ring *B* is rotated with ring *E* until plunger *H* enters the slot in ring *B* next to the one it previously occupied. A reverse motion imparted to handle *F* again tightens the clamping ring *E* on the chuck ring *B* and locks the latter to the base.

In the tightening movement of ring *E*, pawl *I* trips over the slot it engages on the next indexing, and pawl *G* swivels under the plunger. The loosening, indexing, and locking of the chuck itself are quickly accomplished by means of handle *F*, and locking and unlocking of the jaws by a short movement of one of handles *K*. Various lengths of jaws are used to accommodate the different diameters of blanks. To furnish a substantial support for the work, the flat lower end of the blank rests on block *J*. In milling ¾-inch hexagons, the production averages about 50 counterbores per hour.

Milling Five-flute Cutters

In milling the flutes, three counterbores are handled at one time with the set-up illustrated in Fig. 4, double-angle milling cutters being used to produce faces *B* and *C* of the counterbores, as shown at *X*. Fig. 3. For this operation, a special three-spindle head was designed, by means of which the different pieces of work are indexed simultaneously for the various flutes. This special head is used in connection with a standard dividing head which rotates the work-spindles while the table is fed, in order to cut the counterbore teeth spirally. The dividing head is disengaged from the indexing head when indexing, and locked to it after this has been accomplished. The arbor on which the milling cutters are mounted is substantially supported against upward thrust by two vertical adjustable steadyrests attached to the over-arm.

One end of the counterbores is held on the centers of a three-center tailstock, and the hexagonal end is supported in the hexagonal recesses of holders attached to the fixture spindles. These recesses are tapered on five sides of the hexagon to locate the work centrally, while on the sixth side there is a flat hardened plate which registers with one flat of the hexagonal portion of the counterbore for its entire length. This plate is used to drive the piece from the spindle and prevents it from rocking. It also serves to accurately locate one of the flutes centrally with one flat of the hexagon on the counterbore, as will be explained later. The fixture holders are of different lengths to compensate for the angular setting of the tailstock.

The arrangement employed for indexing the work-head is shown diagrammatically in Fig. 7. Thirty teeth are cut around the periphery of plate *A* to provide a means of indexing the main spindle of the fixture and locking it to the spindle of the dividing head, part *F* being screwed on the spindle nose of the dividing head. The locking of the main work-head spindle to the dividing head is accomplished by pawl *B* engaging one of the teeth around plate *A*.

When it is desired to index the work, handle *C* is pulled forward until the inclined part *X* raises pawl *B*, as indicated by the dot-and-dash lines. In the meantime, cam *D* has been rotated past hook *E* so that the spring in back of the hook can push it forward and lock pawl *B* in the raised position. Handle *C* is then pushed in the opposite direction

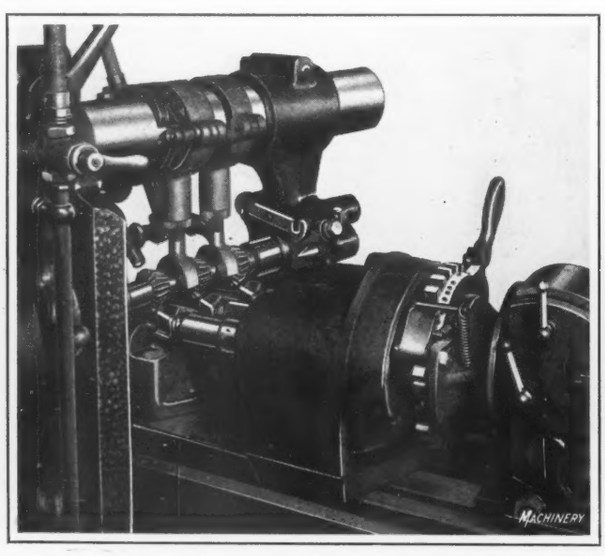


Fig. 4. Milling Five-flute Cutters Three at a Time by Means of a Special Indexing Head and a Standard Dividing Head

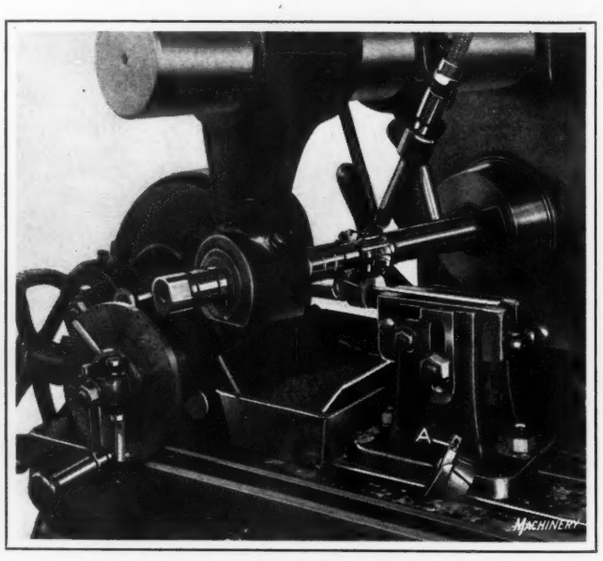


Fig. 5. Milling a Three-flute Counterbore with a Form Cutter, a Different Cutter being Necessary for practically Every Diameter

until cam *D* knocks hook *E* out of engagement with pawl *B* and allows the pawl to enter the first tooth rotated past it. It will be obvious that cam *D* may be set in such a relation to handle *C* that the desired indexing movement will be obtained. Holes are drilled and tapped around the handle plate to permit placing the cam in various positions.

Milling Three-flute Counterbores

Whereas only a few sizes of milling cutters are necessary for fluting the entire range of five-flute counterbores, in milling three-flute counterbores different cutters must be used for each variation of 1/16 inch in counterbore diameter. Three-flute counterbores are carried in stock up to 1¼ inches in diameter, and so it will be apparent that quite a number of milling cutters must be kept on hand. The reason for having to use a different cutter for almost every variation in counterbore diameter is that the cutters must be of the formed type because of the shape of surface *E*, (see view *Y*, Fig. 3). Obviously the contour of this surface changes with the counterbore diameter. Not only must the cutters be made to suit the diameter of the counterbores, but they must also be made in accordance with the angle at which the cut is to be taken, which usually equals 15 degrees.

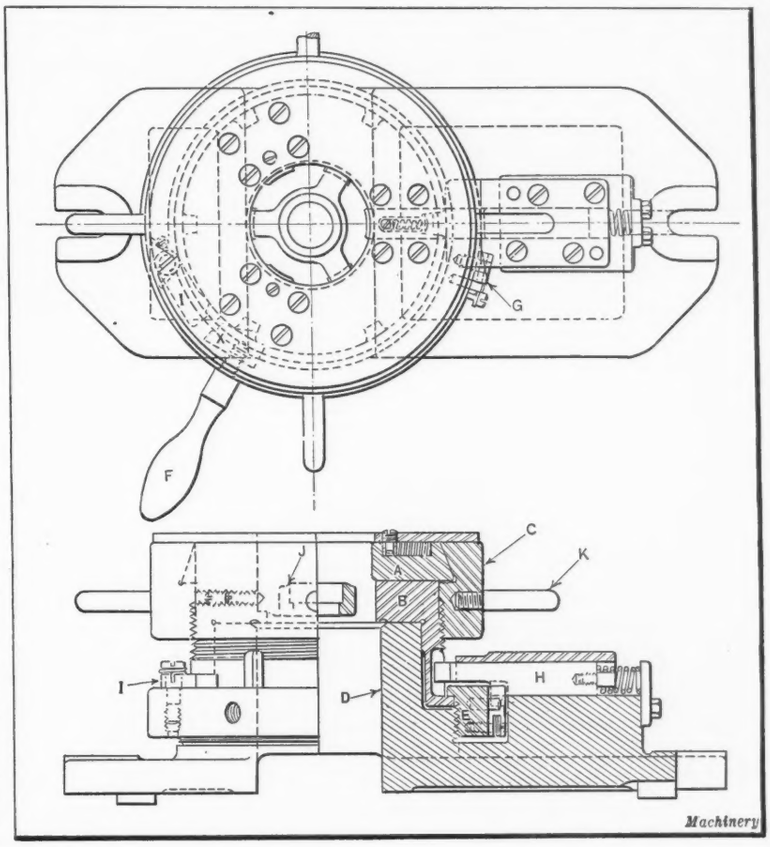


Fig. 6. Details of Construction of the Special Fixture shown in Fig. 1

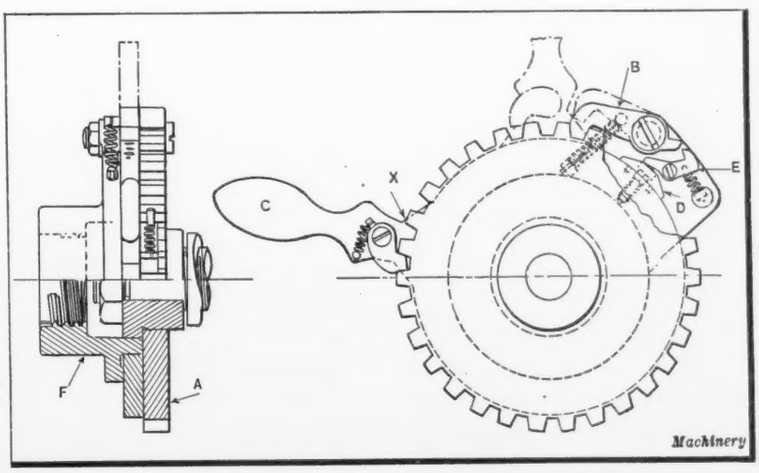


Fig. 7. Indexing Mechanism on the Special Work-head used in fluting Five-flute Counterbores

In Fig. 5 is illustrated the operation of fluting three-flute counterbores one at a time. In this case both the rotation of the counterbore to produce the spiral tooth and the indexing for the different flutes are obtained through the use of a standard dividing head. A work-head of the type illustrated in Fig. 4 has also recently been developed to increase production in this operation by milling three counterbores at one time. In this case also, one of the flutes of type A counterbores must be in line with one of the flats of the hexagon. This is insured by the use of the gage shown at *A* on the shank of a counterbore. This gage has a hexagonal hole in it to permit slipping it on the hexagon of the counterbores, and it must be possible to do this with a vertical edge of the gage in line with one of the flutes. Type B counterbores have a long shank by means of which they are attached to their holders, and in fluting both three- and five flute counterbores of this style, the shank is supported by a holder having saw-clutch teeth.

Gashing Back of the Cutting Edges and Reaming

Another important operation on the counterbores consists of gashing out the excess metal to form the clearance in back of the cutting edges, as shown in Fig. 2. This is an unusual operation, because the surfaces are milled at three different angles. To obtain the proper shape, the work-holding fixture is tilted forward 29 degrees, and to one side, 7 degrees, while the cutter is tapered 10 degrees. A tapered cutter is necessary in order to make the line of the cutting edges even for the full length. If the cutting edge in front of each surface being machined was parallel to the axis of the cutter arbor, a plain cylindrical cutter would produce the desired result. The chuck of the fixture is opened and closed by simply revolving the head with one of the four handles shown, and the indexing is accomplished by manipulating the handle on the base. There is a fine adjustment for height.

An interesting kink is followed in grinding the cutting edges after hardening and tempering, which facilitates the measuring of the diameter. On about every tenth counterbore, a piece of solder is melted diametrically opposite one of the cutting edges before grinding, so as to provide a convenient surface for applying the anvil or spindle of a micrometer to determine the diameter. The solder can afterward be readily knocked off.

Before hardening and tempering, but after all the other machining operations have been performed, the hole that has been previously drilled through the counterbore is reamed by means of the special self-contained unit illustrated in Fig. 8, the work being fed up and down by hand on the spiral reamer. The reamer is driven at a slow speed and removes about 0.0015 inch of stock all around. This outfit is driven from a countershaft through a single pulley on a shaft at the rear of the base casting. From this longi-

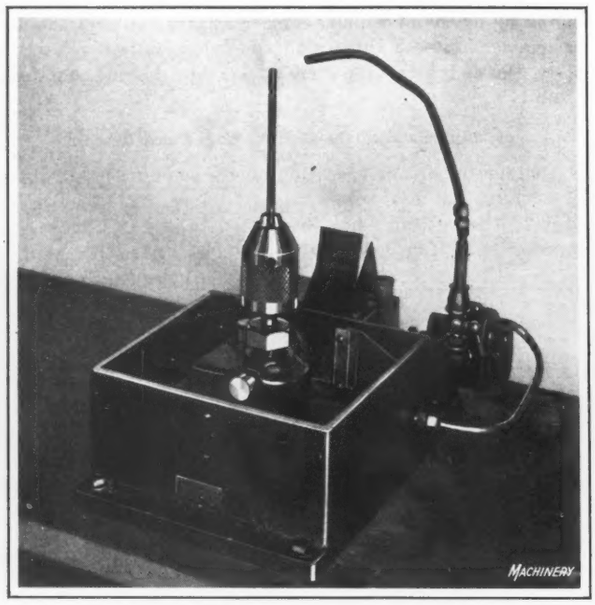


Fig. 8. Self-contained Unit used in reaming the Hole through the Center of the Counterbores

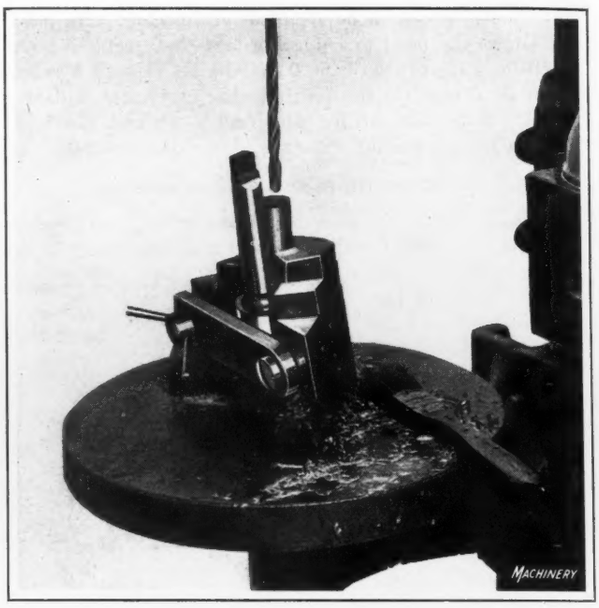


Fig. 9. Jig used in drilling the Hole that contains the Locking Ball in Type B Holders

tudinal shaft power is delivered through reduction bevel gearing to a shaft extending toward the front of the machine and then through worm-gearing to the vertical spindle. The spindle has a taper shank on which the chuck is mounted. There is a pump at the rear right-hand corner of the base which is also connected to the driving shaft through a coupling, and delivers lubricant to the reamer from a reservoir in the base. Simple designs such as this exert a considerable influence in reducing manufacturing costs.

Drilling Holes Accurately in Type B Holders

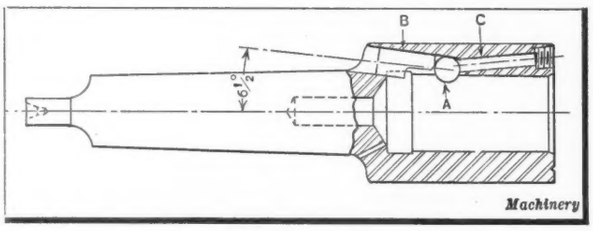


Fig. 10. Sectional View of the Type B Holder

In the long straight shank of type B counterbores, which has previously been referred to, there is a groove cut in the form of a right angle to provide for locking the counterbore to the holder by means of the chrome-nickel steel ball *A*, Fig. 10. It is necessary that this ball project a certain distance into the socket of the holder, and yet the center line of the ball must be outside of the socket sufficiently so that the ball cannot fall through. This means that hole *B* through which the ball is inserted must be drilled accurately relative to the socket. It is also important to drill accurately hole *C* which contains a spring for exerting pressure on the ball. Jigs are used for drilling both holes.

In Fig. 9 is shown the operation of drilling hole *B*, Fig. 10; the holder is held at the same angle as the hole to be produced, the base of the jig being machined on the bottom to suit. The clamp forces the large portion of the holder against six hardened pins set in the form of a vee. Interposed between these pins are six set-screws which may be used for the same purpose on special diameter work. A comparatively long bushing is used, and this is necessarily very thin at the lower end where it hugs the holder shank. Practically the same type of jig is used for drilling the spring hole.

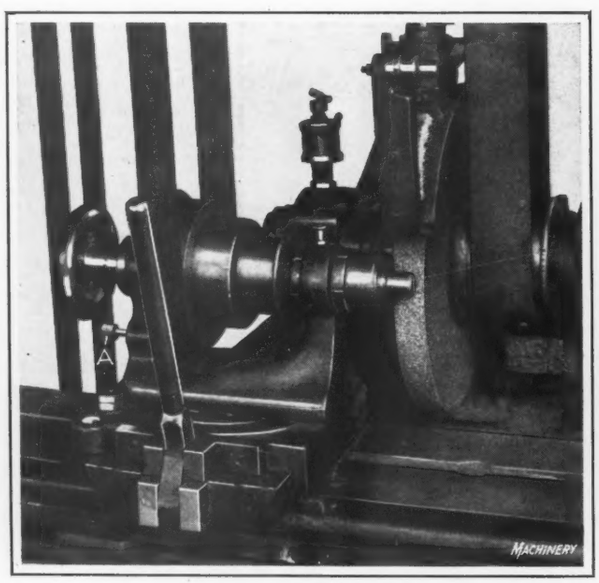


Fig. 11. Special Work-head applied to Grinding Machine to facilitate grinding the Pilot Heads to Size

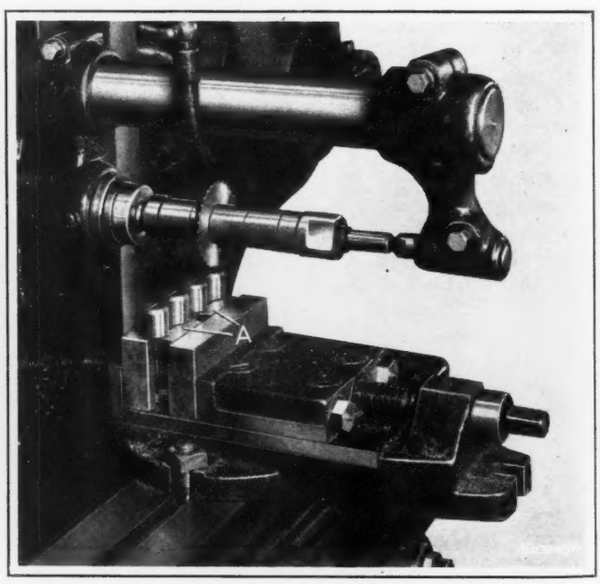


Fig. 12. Method of holding the Pilots on a Hand Milling Machine while cutting the Screwdriver Slot

Before this operation, the holder is turned and cut off from bar stock on a screw machine, and then the socket end is finished in a turret lathe, the hexagonal hole in type A holders being produced by means of a Watts hexagonal drill. The next operation consists of milling the tang on a series of holders at one time, the pieces being held in a special fixture which grips the taper shanks, and two gang milling cutters being used. A collar between the milling cutters limits the depth of cut and consequently the length of the tangs on the holders.

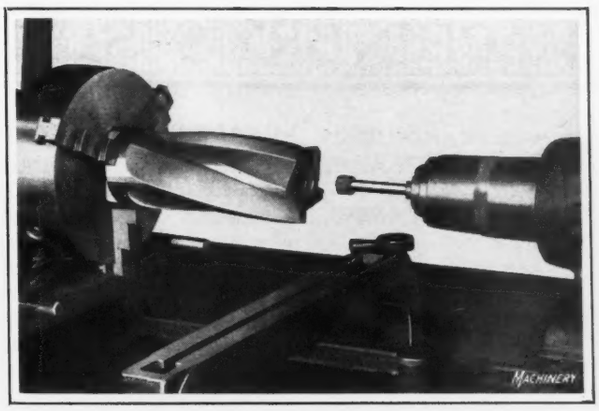


Fig. 13. Grinding a Hole to Size in a Large Core Drill

For grinding the head of type A and B pilots, a special headstock has been applied to a cylindrical grinding machine, as shown in Fig. 11. A baseplate with a dovetailed tongue is attached to the bed, and the work-holding head may be slid back and forth on this base by simply operating the handle. After a pilot has been inserted in the collet chuck of the work-head, the handle is pushed forward until the head is fed against a stop, at which time the work has been ground to the desired diameter. To hold the cone pulley stationary in clamping work in the collet or loosening it, pin *A* is entered into one of a series of holes drilled around the left-hand flange of the pulley. Thus the collet handwheel can be turned without revolving the pulley.

In cutting the screwdriver slot across the end of the pilots, use is made of the special vise jaws illustrated in Fig. 12. One side of each pilot shank is held against a vee in the rear jaw by means of the clamping blocks *A*. Each of these blocks has four short flat surfaces, two of which bear against each pilot shank, while the backs of the clamping blocks are curved to equalize the pressure on the pilot shanks when the front jaw is tightened. The clamping blocks are attached to the front jaw by means of a pin on which the blocks float, and there is a coil spring in the blocks to hold the pilots in place as they are loosened. The lower end of the pilots seats directly on the rear jaw and the clamping blocks. The slitting saws used in this operation range from 1/16 to 1/8 inch in thickness.

Besides being used in holders of the type described, the counterbores are also used in connection with core drills such as shown in Fig. 13. These core drills are machined internally at the lower end in the same way as the holders to receive the counterbores, but they have flutes for carrying chips away from the hole being bored. It is for the purpose of registering the flutes of a counterbore properly with the flutes of core drills that one flute of each counterbore is always located centrally with one flat of the hexagonal portion, as previously mentioned. The operation illustrated consists of grinding the hole in the core drill on which surface *F*, Fig. 3, of the counterbores seat. This core drill is 2 15/16 inches in diameter, about 8 inches long, and has five flutes. The hole was ground 1¼ inches in diameter by using a ½-inch grinding wheel.

Before the counterbores and holders are sent to the stockroom, they are thoroughly inspected for size and hardness. The inspection department is shown in the heading illustration. The man at the left is measuring the diameter of small core drills in a standard measuring machine, and the man at the right is testing the hardness of counterbores under a scleroscope. The counterbores are tested for hardness on the cutting edges, and as these are ground back at an angle of 7 degrees, as shown at *Z* in Fig. 3, it was necessary to fit special bushings into the base on which the scleroscope is mounted, as shown in Fig. 14. These bushings are tilted 7 degrees so as to permit the hammer of the scleroscope to strike a flat surface. Bushings are provided for three different sizes of counterbores. The pin at the side of each bushing holds the cutting edges steady during a test. The scleroscope reading must be between 87 and 95.

At the front of the scleroscope base are shown two gages of the type used to insure that one flute of the counterbores will be central with one flat of the hexagon, and a hexagonal plug gage such as is used for inspecting the hole in type A holders and core drills. Circular plug gages and ring gages are also used for inspecting type B cutters, holders, and core drills. Counterbores, core drills, and holders are completely finished before being sent to stock, but the pilot heads are simply ground to approximate size and finish-ground to suit the individual requirements of shops.

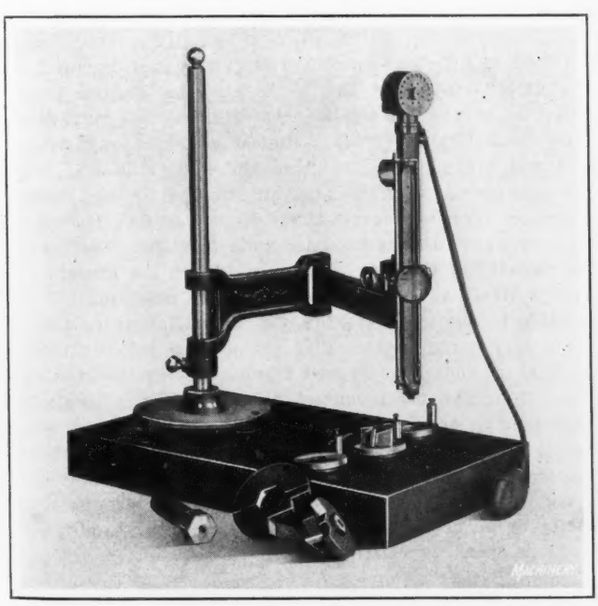


Fig. 14. Scleroscope Base fitted with Tilted Bushings for Use in testing the Cutting Edges of the Counterbores

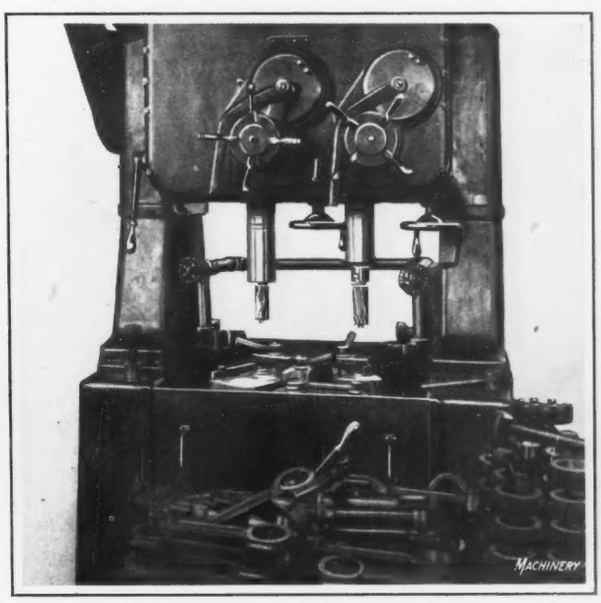


Fig. 15. Counterbores and Core Drills being used for rough-boring and reaming the Crankpin Bearing of Connecting-rods

PIANO WIRE

Piano wire, also known as *music wire*, is the highest grade of steel wire drawn. It has an ultimate strength of from 300,000 to 340,000 pounds per square inch, the wire being drawn in comparatively small sizes only.

CONDENSATION LOSSES IN ENGINE CYLINDER

The principal waste of steam in steam engine operation is due to condensation during the stroke. This occurs because of the fact that during expansion and exhaust, the cylinder walls and head and the piston are in contact with comparatively cool steam, and, therefore, give up a considerable amount of heat. When fresh steam is admitted at a high temperature, it immediately gives up sufficient heat to raise the cylinder walls to a temperature approximating that of the entering steam. This results in the condensation of a certain amount of steam, the quantity depending upon the time allowed for the transfer of heat, the area of exposed surface, and the temperature of the cylinder walls. During the period of expansion the temperature falls rapidly, and the steam, being wet, absorbs a large amount of heat. After the exhaust valve opens, the drop in pressure allows the moisture that has collected on the cylinder walls to evaporate into steam, so that, during the exhaust period, but little heat is transferred. With the admission of fresh steam at boiler pressure, a mist is condensed on the cylinder walls, which greatly increases the rapidity with which heat is absorbed. The amount of heat lost through cylinder condensation is best shown by a practical illustration. One horsepower is equal to 33,000 foot-pounds of work per minute, or $33{,}000 \times 60 = 1{,}980{,}000$ foot-pounds per hour. This is equivalent to $1{,}980{,}000 \div 778 = 2550$ heat units. The latent heat of steam at 90 pounds gage pressure is 885 heat units; hence, $2550 \div 885 = 3$ pounds of steam at 90 pounds pressure required per horsepower, provided there is no loss of steam, and all of the contained heat is changed into useful work. From 30 to 35 pounds of steam are required in the average simple non-condensing high-speed engine. The most effective method of reducing condensation losses is by so designing the engine that expansion occurs in two or more stages as in compound and triple-expansion engines.

WROUGHT PIPE DEFINED

There seems to be some confusion as to the meaning of the terms "wrought pipe" and "wrought-iron pipe." At one time they were practically synonymous, for originally all pipe was made of wrought iron, but the use of steel pipe has increased so rapidly that now at least 90 per cent of the wrought pipe made in this country is of that material. "Wrought pipe" is a term that is applied to both steel and iron pipe. The term "wrought-iron pipe" means that the pipe is made of wrought iron, which is the product of the puddling furnace; while "steel pipe" is applied, of course, only to pipe made of steel.

PRESSED STEEL

The term "pressed steel" is commonly applied to parts made from sheet steel by the die and press method. Pressed-steel parts have been used in many lines of manufacture to replace castings, forgings, and machined parts. The advantages of using pressed-steel parts often include such factors as reduction in weight and accompanying reduction in cost of raw materials and transportation charges for finished products; increased strength, as compared with replaced parts; larger production; and improved appearance of finished parts.

ROYALTIES ON PATENTED ARTICLES

The customary royalty paid by manufacturers for the privilege of manufacturing and marketing patented mechanical devices may be either a certain percentage of the selling price or a certain fixed amount for each article manufactured, but the amount varies in almost every case because of the endless variety of conditions that affect royalties. It is not feasible to give general figures, as a royalty which is too high in one case may be entirely too low in another. For instance, when the manufacturer must invest in new equipment, and when the cost of selling a product is likely to be high, it is apparent that the manufacturer should have a larger royalty than would be required if the risk assumed were less. Because of these variable factors, 5 per cent royalty might be fair to both patentee and manufacturer under given conditions, and too low under other conditions. In other words, it is not feasible to establish the royalty by considering what someone else has done, but rather to establish it on a business basis, considering the facts covering the particular case under consideration.

TYPE METAL

Type metal is used for casting type for the printing trades and also for light high-speed machine bearings which are not likely to become heated. For bearings, it is used in the form of a lining like babbitt metal. Type metal is a comparatively cheap alloy, because it contains a large percentage of lead (80 per cent of lead and 20 per cent of antimony), and, when cheapness is an important consideration, there is a tendency to use this lining metal instead of the more expensive babbitt alloys containing copper and tin. Type metal bearings should not be used, however, when heavy loads have to be supported by the shaft.

HELICAL GEAR CHARACTERISTICS

Helical gears for parallel shaft drives have several inherent advantages as compared with the spur type. First, the action is distributed over more than one tooth, and all phases of tooth engagement, such as sliding and rolling contact, occur simultaneously, which tends to equalize wear and preserve the correct tooth shape. The load is transferred gradually and uniformly as successive teeth come into engagement, and the bending action resulting from the tooth load is less than for a spur gear, because the line of contact extends diagonally across the meshing teeth; the tooth load of a helical gear, however, is higher because of the angular position of the teeth, and the normal tooth section is, of course, smaller than that of a spur gear of the same circular pitch. Helical gearing for driving shafts which are not intersecting and not parallel is generally considered a rather treacherous type to use, when the amount of power is relatively high. In most installations, the power transmitted is much less than the maximum capacity of the gearing, and whenever the amount of power is likely to be anywhere near the maximum, it is preferable to use worm-gearing, the worm having as many threads as are required to give the desired velocity ratio. Helical gears that have caused trouble due to abrasion resulting from the small contact area and highly localized pressure, have often been replaced by worm-gearing with satisfactory results. Whenever there is any doubt about the power-transmitting capacity of helical gearing, it is not advisable to rely upon calculations, but to determine this capacity by an actual test under actual running conditions, as regards speed, lubrication, and load.

MACHINERY'S SCRAP-BOOK August 1924

GRINDING WHEEL COLORS

The color of both aluminum-oxide and silicon-carbide grinding wheels depends on the material used to hold the abrasive particles together, which is termed the "bond." The exact shade, however, is likely to vary somewhat with wheels of the same bond that are produced in the same heat, and so a slight variation in the shade of two wheels does not necessarily indicate a difference in grade. The four most important bonding processes are known as the vitrified, silicate, elastic, and rubber processes, and these names are applied to the grinding wheels produced by them. The use of different bonds permits the manufacture of wheels of different characteristics to suit all classes of grinding. Vitrified wheels are standard for most grinding operations, the other kinds being used when special conditions are encountered. Probably 80 per cent of all grinding wheels are vitrified. Vitrified wheels can be readily distinguished from the other wheels by their reddish or reddish-brown color, and the clean ringing sound which results when they are tapped. Silicate wheels are easily recognized by their light gray color. Elastic and vulcanized wheels are almost black, but they may be distinguished by their odor when subjected to the friction of a grinding operation or when a small part is burned. Elastic wheels emit an aroma, whereas rubber wheels give off the odor of burning rubber.

SWITCHES OF AIR-BREAK TYPE

An air-break switch has contacts which make and break contact in the air as contrasted with an oil switch in which the contacts make and break under oil. The air-break switch may be enclosed by some form of cover for the purpose of protecting the operator or to prevent unauthorized operation. Air-break switches can be used up to any voltage or current commercially feasible. The construction varies according to requirements. There are several kinds, such as lever, brush, rotary, plug, and push-and-pull switches.

BABBITT METAL COMPOSITION

The exact composition of the original babbitt metal is not known. The ingredients were copper, tin, and antimony, in approximately the following proportions: 89.3 per cent tin; 3.6 per cent copper; 7.1 per cent antimony. This metal has great anti-frictional qualities, but the high percentage of tin makes it expensive and has led to the substitution of other metals which are marketed under the name of "babbitt metal." These cheaper grades, when properly made, are superior to the original babbitt metal for some purposes. The composition of babbitt metal should be varied according to the pressure to which it is subjected and the speed of the rotating member; the size of the bearing and thickness of the babbitt metal lining should also be considered. While it is not necessary to use a different composition for each slight variation, a different grade is preferable when the conditions are radically different.

BELT SPEEDS

Low belt speeds are often the cause of inefficiency and waste of power. Whenever possible, belts for transmitting power should be run at from 4000 to 4500 feet per minute, while they are frequently run at only 1000 feet per minute. As a result, wide belts are being used when a narrower belt, running at a high speed, would prove both cheaper and better. In addition, bearing pressures would be lessened and the friction and accompanying wear and power consumption reduced; thus, the expense for belts, fuel, and oil would be decreased to a considerable extent.

FILE DURABILITY

It has been estimated that the useful life of a file is, on an average, 25,000 strokes, which is equivalent to two full working days of ten hours each. Files should be discarded as soon as they have passed through the period of useful life, because worn files are expensive to use.

NATURAL ALLOY STEEL

Natural alloy steel is so designated because of the fact that this class of steel is manufactured from an ore in which nickel and chromium are alloyed by nature. About 1900, this ore was discovered at Mayari and Moa in the Province of Oriente, in the eastern part of Cuba. These ores show a remarkable uniformity of composition and cover some 25,000 acres. The various grades of steel into which this ore is manufactured contain from 1.00 to 1.50 per cent of nickel; from 0.20 to 0.70 per cent of chromium; from 0.15 to 1.50 per cent of carbon; and from 0.50 to 0.80 per cent of manganese; the silicon is kept below 0.20 per cent, and the phosphorus and sulphur, below 0.04 per cent. These two latter elements, however, seldom reach 0.035 per cent, and a phosphorus content that is below 0.02 per cent is often obtained. These natural alloy steels are made by the open-hearth process and are, in the heat-treated condition, equal to 3½ per cent nickel steel. In some ways, they are superior to this steel and especially is this true of the grade that contains the higher percentages of chromium, or when they are manufactured into parts that have a comparatively large sectional area. They are also cheaper than the nickel steels made by the same process. Natural alloy steel can be hammered, rolled, drop-forged, pressed, stamped, or machined with the same ease and at the same temperatures as carbon steel; no special precautions are necessary. Natural alloy steels, like all other steels, will attain the highest strength only when properly heat-treated. In the untreated or annealed state, they show a tensile strength and elastic limit that is from 8000 to 10,000 pounds per square inch higher than carbon steels of the same carbon content, but, when properly heat-treated, they compare favorably with other alloy steels.

NAPIER MOTION

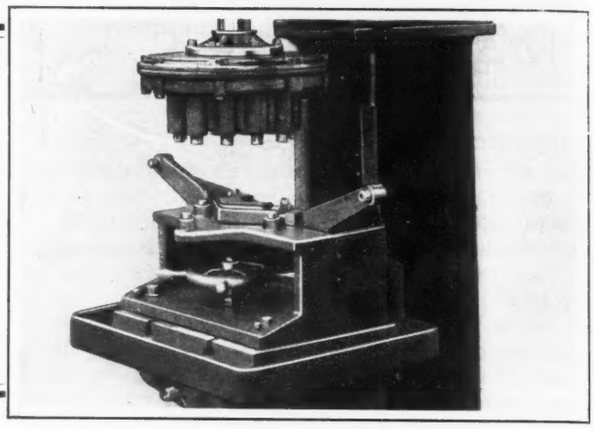
When a gear or pinion is in mesh with a single rack and rotates in one position, obviously both the gear and rack must reverse their direction of motion at the end of each stroke if a reciprocating motion is to be imparted to the driven member to which the rack is attached. The gear, however, may rotate continuously in one direction if it is arranged to engage the upper and lower sides of a rack designed especially to permit such engagement. A mechanism of this type, known as the Napier motion and also as "mangle gearing," has been used for imparting a rectilinear motion to the tables of flat-bed printing presses.

INDUCED DRAFT

The induced draft system of a power plant has a fan placed between the furnace and the chimney, and the air is drawn through the furnace by suction. This corresponds with the natural draft produced by a chimney, and also permits of the use of an economizer in the main smoke connection. With this arrangement, all leakage is inward and there is no danger of dust and smoke being blown into the fireroom, as with forced draft. On the other hand, a system of induced draft is more expensive to install, because the gases, being at a higher temperature, have a greater volume, and require a higher speed and more power to move them.

Possibilities of Heavy-duty Drilling

By HERBERT L. TIGGES, Sales Engineer,
Baker Bros., Toledo, Ohio



THE selection of the proper machine tool to use for various operations is one of the principal problems confronting a manufacturer. Many different views are taken by tool and equipment engineers, and, of course, each plant has its own reasons for handling the same operations in different ways and on different types of machines. Because the individual conditions govern the choice of the proper machine for a given operation, it is practically impossible to standardize on one type of machine for an operation. The universal aim is to secure the lowest cost possible per piece, and in this endeavor there are many important points to keep in mind, among which may be mentioned the floor space available, the initial and upkeep costs of machines, the question as to whether or not the investment will be profitable, the cost of tooling the machine, and labor conditions.

The majority of installation engineers will agree that one of the fundamental points in selecting machine tools is to choose standard single-purpose machines wherever possible. Numerous expensive ventures have been made in recent years in the way of highly specialized machinery, and in many cases, standard machines have replaced the special ones to give larger production at less costs. This article will point out the possibilities of the vertical heavy-duty drilling machine by presenting examples of work done in automobile plants. This industry is chosen because it is, today, the leading user of machine tools, and its experiences are of value to all large production plants. As the experience of the writer has been mainly with Baker Bros., Toledo, Ohio, all the examples consist of work done on machines built by that concern. By the term "heavy-duty drilling machine" is meant a machine with a box column. This construction lends itself not only to drilling operations, which will later be shown to be greatly in the minority, but to boring, forming, tapping, and facing operations.

Drilling machines for use in production are usually built as single-purpose tools, and the different speeds and feeds are obtained by means of quick-change gears. One important point in their design, upon which production depends to a considerable extent, is the fact that all operating levers and handles can readily be placed within easy reach of the operator. The second feature is the small amount of floor space required for the machine. This advantage is of great value in instances where the space available for machinery is limited, and where a machine that will produce the same or more pieces per hour and yet occupy much less space, is naturally preferred. Plenty of space is usually available between the floor and the roof, and it is this space that the vertical drilling machine utilizes.

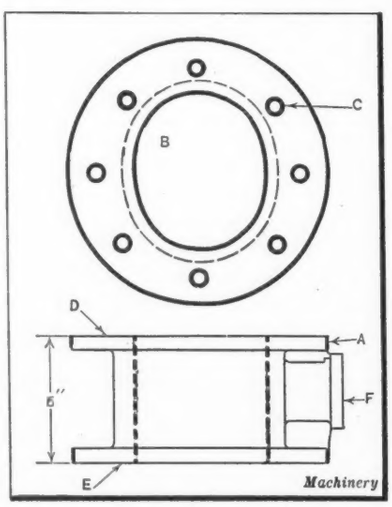


Fig. 1. Casting which is finished on the Heavy-duty Drilling Machine

As a striking example of economy effected with the vertical heavy-duty drilling machine, the reader is referred to the part shown in Fig. 1, which is a casting used in connection with pumps. All the surfaces indicated by the heavy lines are finished on a gang of these machines, and one point of particular interest is the elliptical hole *B*. Previous to machining this part on the gang drilling machine, the operations required about 1¼ hours, and one operator was needed for each machine used. The operations consisted of turning surface *A*, and finishing hole *B*. Surfaces *D*, *E*, and *F* are milled before turning and boring.

Drilling, Turning, and Boring Pump Casting

When the work is done on a gang drilling machine, the same operations are performed as previously mentioned, and, in addition, holes *C* are produced. The first spindle on the drilling machine is equipped for turning surface *A*, the second spindle for drilling holes *C*, and the third and fourth spindles for boring hole *B* by using a special fixture and a cam-operated tool. One part is turned out every 20 minutes, and the four spindles are served by one operator and a helper. To obtain this production by the methods previously used four operators and four machines would be necessary; furthermore, the approximate floor space required for the drilling machine is 40 square feet, as against 160 square feet for the four machines mentioned.

There are many other fields of use for the heavy-duty drilling machine outside of the automobile industry, and it must not be inferred that quantity production is necessary for the economical use of this machine. One example is the railroad shop, where in most cases a large production is not required, but where many different parts are produced in small numbers. Special fixtures and single-purpose machines are not warranted in such shops, and this is where the flexible type of heavy-duty machine, arranged with quick-change speed and feed boxes can be installed to advantage.

Boring and Reaming Connecting-rods

Various methods of machining connecting-rod forgings on the heavy-duty drilling machine are employed in automobile plants, the method depending on the particular design of the rod. Two popular methods will be described in the following. In the first of these, the procedure is to rough-bore the crankshaft bearing hole and rough-drill the wrist-pin hole 1 3/16 inches in diameter on a two-spindle machine with a distance of about 10½ inches between the spindle centers. For the large hole, the boring-bar revolves at about 100 revolutions per minute, the feed is 0.013 inch per revolution, and the length of cut, about 1⅞ inches. The small hole is broached for the final finish, but as

the bearing for the crankshaft is die-cast, the larger hole need not be finished. The production obtained averages about 300 rods per nine-hour day.

In the second method, the crankshaft bearing hole is rough-bored and then reamed to 2.375 inches in diameter on a four-spindle gang drilling machine, while the wrist-pin hole is drilled and reamed on a two-spindle machine equipped with a three-station indexing table. The production on each machine is 50 pieces per hour, and each machine requires an operator.

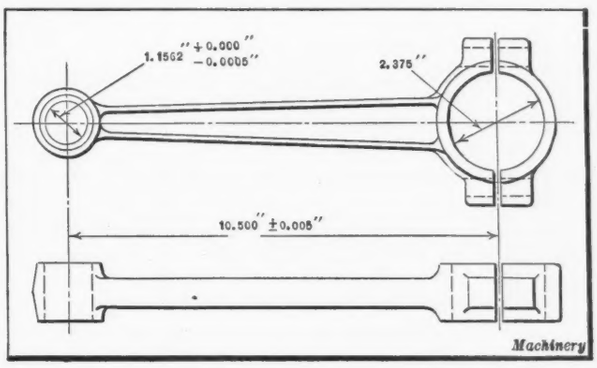


Fig. 2. Automobile Connecting-rod which is bored and reamed

The drilling and reaming of the bolt holes for the cap are also performed on machines of this type, and there are two general methods in use. With the first method a two-spindle machine is used in which each main spindle is equipped with either a two- or a four-spindle head, depending on the design of the rod. For instance with a four-hole rod the four holes, usually drilled 9/32 inch in diameter, would be produced at one time with a drill speed of about 490 revolutions per minute and a feed of about 0.004 inch. The four holes are then reamed to 5/16 inch in diameter under the second spindle, at a cutter speed of about 320 revolutions per minute and a feed of about 0.006 inch. With an indexing table that provides for reloading the work while the machine is in operation on other rods, the production averages 85 rods per hour. In the second method, two single-spindle machines equipped with four-spindle heads are used, the work being first drilled on one machine and then rechucked on the second for the reaming operation.

Methods of Machining Transmission Housings

Transmission housings constitute another example of work on which several operations can be readily performed by means of heavy-duty drilling machines. At *X*, Fig. 3, is shown a cast-iron housing which is handled on a three-spindle gang machine after surface *K* has been milled. Bores *B* are finished under the first spindle of this machine, the spindle speed being about 70 revolutions per minute, the feed 0.028 inch per spindle revolution, and the length of cut 5½ inches. Bores *C* are next finished under the second spindle with a spindle speed of 100 revolutions per minute and a feed of 0.028 inch per revolution, the length of cut being 11 inches. Finally counterbore *A* is produced under the third spindle. The boring-bars in the first and second spindles carry three tools for taking a similar number of cuts at one time. One operator only is required for this machine, and the production averages 15 housings per hour.

The cast-iron housing shown at *Y* has holes *H* finish-bored on a two-spindle cylinder borer. Before coming to this machine, surface *E* is milled. Two castings are finish-bored at one setting, the boring-bars used carrying three cutters for taking three cuts. They are piloted below and supported above in a guide bushing. In this operation, the spindle has a speed of about 85 revolutions per minute and a feed of 0.045 inch per revolution, the production averaging 450 housings per nine-hour day.

The malleable-iron housing illustrated at *Z* is finished on single-spindle machines in three operations. In the first of these, holes *B* are rough-bored, two machines being handled by one operator and producing, together, about 300 housings per nine-hour day. The casting is chucked in a 180-degree tumbler fixture and bored from both ends. It is then finish-reamed in a second operation, the casting being set over a plug to ream the top bore, after which it is reset over another plug to ream the opposite end. One man operates one machine and produces approximately 300 housings per nine hours. Face *A* is finished in the third operation, the casting being chucked over a plug which registers in the lower hole *B*. In this set-up the tool is piloted through a hole in the plug. With a hand feed for the spindle, the production averages about 300 pieces per nine hours.

Differential Carrier and Rear Axle Housing

Thus far the examples shown have involved only drilling, boring, and reaming operations, but Fig. 4 shows a differential carrier which is also tapped under the heavy-duty drilling machine. Bores *B* are rough- and finish-bored on a five-spindle gang drilling machine, each spindle having a 30-inch length of cut. The casting is held in a box fixture which is mounted on tracks to facilitate sliding it from one spindle to the next. Each boring-bar is piloted below and supported above.

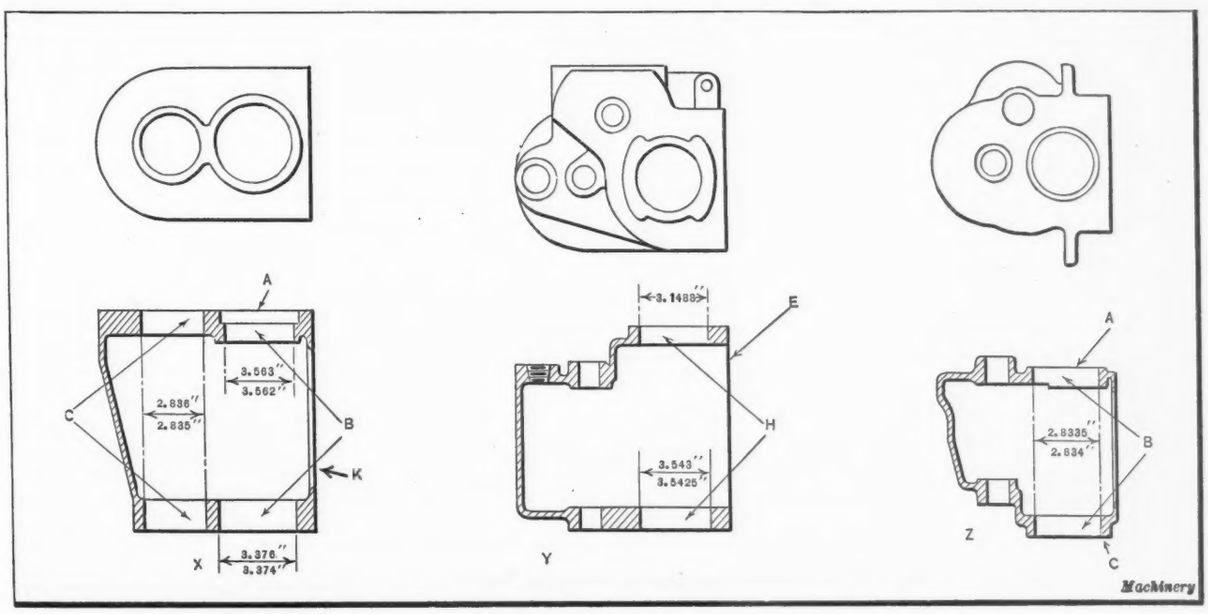


Fig. 3. Three Transmission Housings bored and reamed on Heavy-duty Drilling Machines

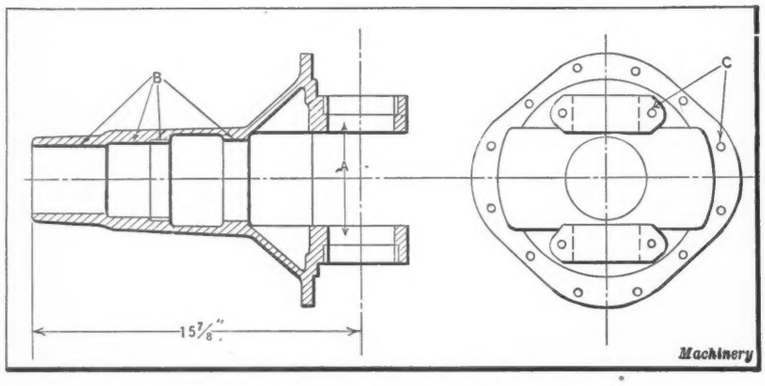


Fig. 4. Differential Carrier which is tapped in Addition to boring

Under the first and second spindles, three diameters are rough-bored, with a spindle speed of 60 revolutions per minute, and a feed of 0.040 inch per revolution, the length of cut being 4 inches. Under the third spindle, the three diameters are semi-reamed, while under the fourth, they are finish-reamed. Finally, under the fifth spindle, a collapsing tap, 3 5/16 inches in diameter, having 16 threads per inch, with geared lead to the spindle, is used to tap the central bore. The fixture track encircles the machine, and two men are employed at the rear to load and unload, while two other men operate the machine from the front. With this installation the production averages 300 carriers per eight hours.

In the second operation on the same part, bores *A* are finished and tapped at the outer ends to 3⅝ inches diameter and 16 threads per inch. This operation is also performed on a five-spindle gang machine in the same manner as the first, and the production is about 320 parts per eight hours. The sixteen holes *C* are drilled in a third operation under a heavy-duty drilling machine equipped with a sixteen-spindle head. The twelve flange holes are drilled to 26/64 inch diameter at a speed of 713 revolutions per minute and a feed of 0.005 inch per revolution, while the four bearing cap holes are drilled to 31/64 inch diameter at a speed of 535 revolutions per minute and a feed of 0.006 inch. The production on this machine is about fifty parts per hour.

Heavy-duty drilling machines are also used for facing the front surface *A* of the pressed-steel rear-axle housing shown in Fig. 5, and for drilling the twelve 5/16-inch holes on each side of this part, as shown at *B*. This operation is handled by a specially arranged single-spindle machine, the outside diameter of the sweep being 13¼ inches, and the width of the faced surface, 1 inch. A hand feed is employed, and the production with this equipment is 20 housings per hour.

For the second operation—drilling the twelve holes—a single-spindle machine equipped with a twelve-spindle head is used. The speed of the drills is 733 revolutions per minute, the feed 0.003 inch per revolution, and the length of cut ½ inch. The holes are drilled on both sides of the housing at the rate of 60 parts per hour. The twelve holes are finally tapped on a single-spindle machine, with a twelve-spindle head equipped with the special tapping and work-holding fixture shown in the heading illustration.

* * *

PROGRESS OF ELECTRIC DRIVE

The American Steel & Wire Co. is undertaking almost complete electrification of its three plants in Worcester, Mass. Eleven steam engines will be scrapped and supplanted by Westinghouse electric motors, having a total horsepower of 12,000, ranging from 1 to 250 horsepower for each motor When completed, this will probably constitute the largest electrically driven wire mill in the world.

RULES FOR DIMENSIONING WITH TOLERANCES

As chairman of the special committee on methods of expressing limits and tolerances, of the Society of Automotive Engineers, Earle Buckingham of the Pratt & Whitney Co., Hartford, Conn., has submitted the following five rules for dimensioning:

1. Only one dimension in the same straight line can be controlled within fixed tolerances; that is the distance between the cutting surface of the tool and the locating or registering surface of the part being machined. Therefore, it is incorrect to locate any point or surface with tolerances from more than one point in the same straight line.

2. Every part of a mechanism must be located in each plane. Every operating part must be located with proper operating allowances. After such requirements of location are met, all other surfaces should have liberal clearances.

3. Dimensions should be given between those points or surfaces that it is essential to hold in a specific relation to each other. This applies particularly to those surfaces in each plane that control the location of other component parts. Many dimensions are relatively unimportant in this respect. It is good practice in such cases to establish a common locating point in each plane and give, as far as possible, all such dimensions from these common locating points. The locating points on the drawing, the locating or registering points used for machining the surfaces, and the locating points for measuring should all be identical.

4. The initial dimensions placed on component drawings should be the exact dimensions that would be used if it were possible to work without tolerances. Tolerances should be given in that direction in which variations will cause the least harm or danger. When a variation in either direction is equally objectionable, the tolerances should be of equal amount in both directions, or "bilateral."

5. The initial clearance, or allowance, between operating parts should be as small as the operation of the mechanism will permit. The maximum clearances should be as great as the functioning of the mechanism will permit.

* * *

The National Machine Tool Builders' Association has formally proposed to the American Engineering Standards Committee that there should be a standardization of the important dimensions of electric motors for use on machine tools. It is particularly desired that there be a standardization of the distance between the motor feet, both longitudinally and laterally, and also of the height of the motor shaft from the bottom of the feet. This distance could and should be standardized for motors of a given rating, so that the same baseplates could be provided, regardless of the make of motor. This dimensional standardization, it seems, should present no grave difficulties.

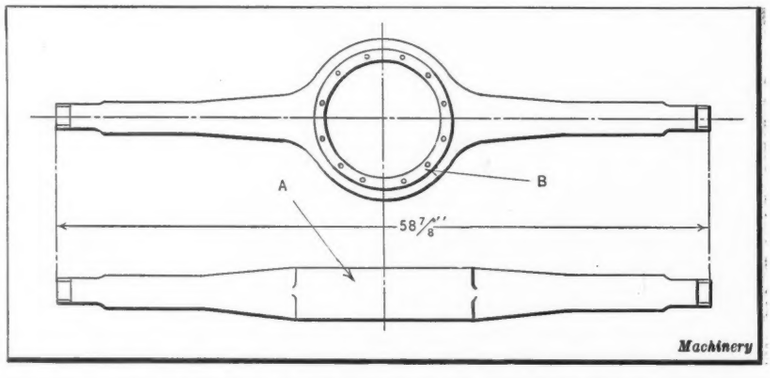


Fig. 5. Pressed-steel Rear-axle Housing faced on One Side and drilled and tapped on Both Sides

Plate and Coil Clutches

By ALBERT CLEGG

THE single-plate clutch is closely related to the double-cone clutch, the main difference being that the former has flat friction surfaces instead of conical ones, which means that the axial pressure required to squeeze the friction surfaces together must be considerably greater, because there is no wedging action, as in the cone type. In Fig. 1 is shown a plate clutch made by the Hilliard Clutch & Machinery Co., Elmira, N. Y., in which the necessary friction for driving is secured by the use of three equally spaced screws operated by means of small spiral gears.

Hub *A* is keyed to the shaft and carries flange *B* and friction plate *C*. The latter is tapped to receive the three screws, one of which is shown at *H*. The hub flange carries the three screws, with their spiral gears *G* and ball thrust bearings; hence these parts and the friction plate and hub revolve with the shaft. The other member *F* of the clutch contains a steel ring *D* which carries a number of fiber blocks *E*. By clamping the blocks between plates *B* and *C*, ring *D* and part *F* are made to revolve with the shaft.

Shipper *J* carries three racks having angular teeth which mesh with the spiral gears on the clamping screws. Any movement in or out of these racks causes each screw to revolve and either draw friction plate *C* against the fiber blocks or release it. The clutch can be readjusted by drawing the racks out of mesh with the gears, turning each screw forward an equal amount, and re-engaging the racks. A stop prevents the racks from being disassembled accidentally. This plate clutch is not affected by centrifugal force, and another point of the design is that the closing mechanism is of the non-harmonic type, the leverage being constant.

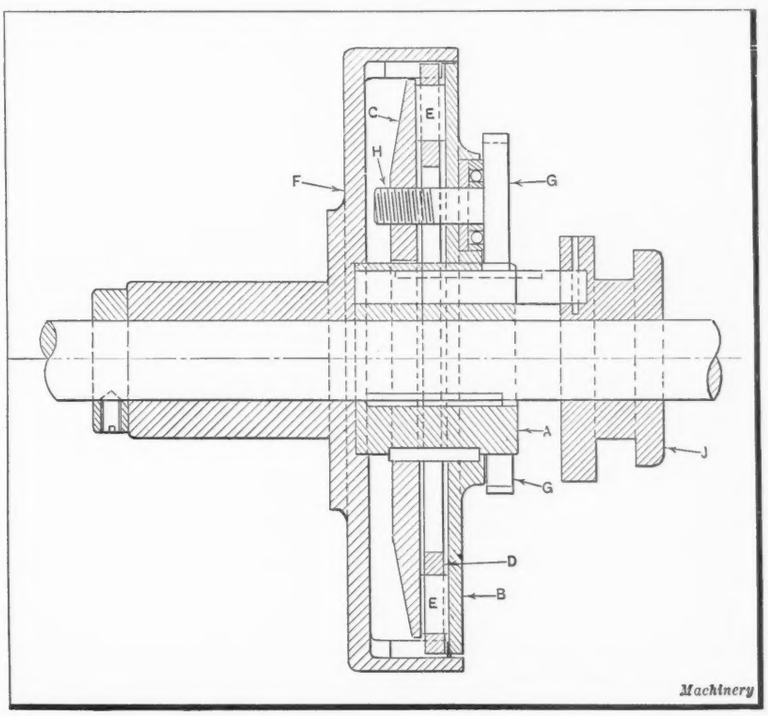


Fig. 1. Single-plate Clutch in which the Plate is operated by Means of Small Spiral Gears and Screws

Magnetic Clutch Drive for Planers

One of the most interesting types of plate clutches applied to machine tools is the Vulcan patented magnetic clutch, designed for use on planers, an application of which is shown in Fig. 2. This clutch differs from the previous example in that it transmits power through a single pair of friction surfaces instead of a double pair, another vital difference being that the pressing together of the friction surfaces is effected by magnetic attraction instead of by mechanical means. The friction surfaces are of different materials, one being of cast iron and the other of wood which is so mounted as to be easily renewable. The design illustrated gives two cutting speeds with a constant-speed return. The two-speed cone pulley *A* is used for the cutting stroke, while the single pulley *B* is used for the return stroke. Both the cone and single pulley are mounted on ball bearings and driven from one countershaft—the cone pulley by an open belt, and the other by a crossed belt. Forged solid with pulley shaft *C* is a plate *D* which separates the two pulleys, and is provided with two wooden rings *K*, one on each side of the plate. These wooden rings are alternately drawn against circular facings *E* and *F* on the two pulleys, the closing force being supplied by magnets *G* and *H* which are energized through the medium of a switch operated by the adjustable dogs on the table. Springs *J* provide for both pulleys being held out of engagement with friction plate *D* when the current is cut off from the respective magnets.

It should be particularly noted that the reversing parts are light, while the two constantly running pulleys *A* and *B* are of heavy proportions. The object is to minimize the power required at the moment of reversal, the stored energy of the pulleys being transmitted to the driving shaft and thus assisting the belts to cope with the momentary overload. By making the parts that reverse as light as possible, and by coupling these parts to a comparatively heavy constantly running pulley, the momentum of the pulley is used to stop and start the reversing parts. It is claimed that no trouble is experienced in the operation of this clutch, and the adjustment required about every twelve or eighteen months can be made in a few minutes. Tests on heavy planers equipped with this drive have shown a time efficiency of 97 per cent on the full stroke, and 65 per cent on a 12-inch stroke, the power efficiency being 75 and 71 per cent, respectively.

The drive can be used to speed up old planers, one such example being a 4- by 12-foot machine originally running at a cutting speed of 28 feet per minute and a return speed of 75 feet per minute. After this drive was supplied, there were two cutting speeds of 58 and 100 feet per minute and a constant-speed return of 165 feet per minute.

Coil Clutches

Three designs of coil clutches patented by Ganz & Co., Budapest, Hungary, are illustrated in Figs. 3, 4, and 5. Formerly when a single coil unit was employed in this type of clutch, the shaft could be rotated in one direction only. In the present designs, this difficulty has been overcome, so that while there is only one coil per clutch, the shaft can be rotated in either direction. In the design shown in Fig. 3, clutch member *A* is machined conical inside, while

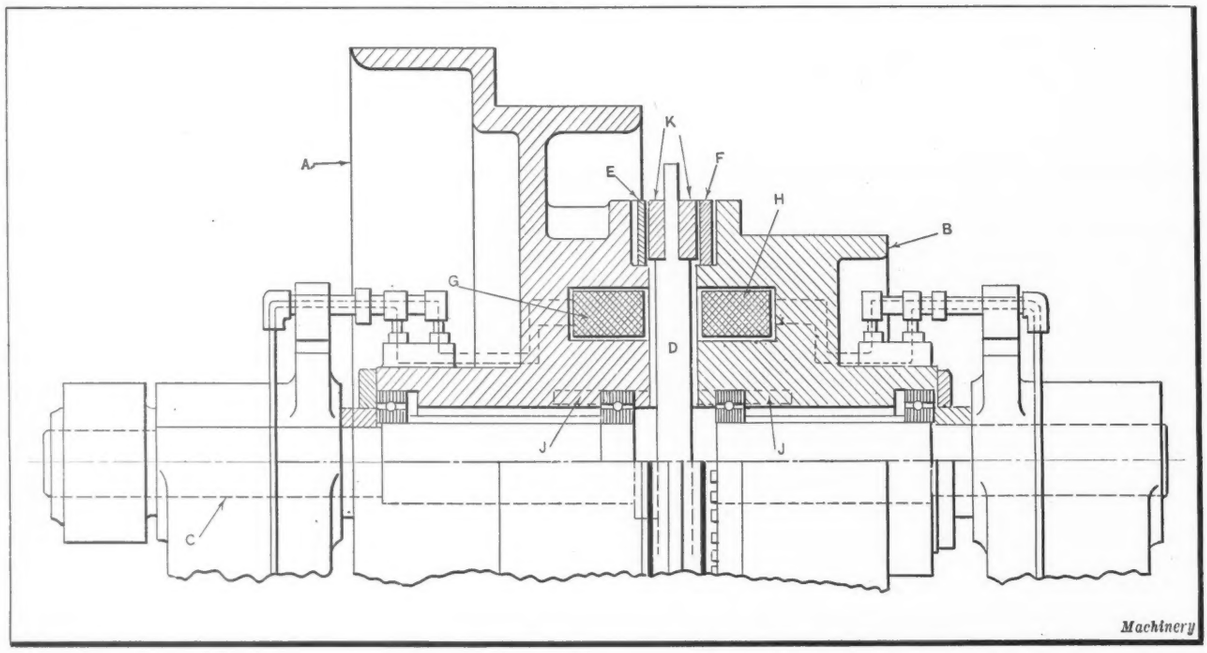


Fig. 2. Planer Clutch in which the Friction Member is pulled either to the Right or the Left by Magnetism

member *B* is turned parallel on the external cylindrical surface that receives coil *C*. This coil is conical on its outer periphery, and is not rigidly connected to member *B*.

The two ends of the coil rest against stops *K* and *N* on member *B* in such a way that the coil may slide or become compressed or extended according to the amount of play afforded by the stops. Between the inner surfaces of the coil and part *B* there is only a very slight play. Member *B* is keyed to the shaft which is to be driven, but is free to slide on it, while part *A* is rigidly secured to the driving shaft in such a way that it cannot be displaced endwise. By moving member *B* toward the left, the coil comes into contact with the inner face of part *A*, and friction is set up, so that both the coil and part *B* are driven (the latter by means of stops *K* and *N*) in the same direction as that in which part *A* rotates.

In the design shown in Fig. 4 the friction surfaces of both clutch members *A* and *B* are cylindrical, and both parts are fixed to their respective shafts so as to prevent end movement. In the inoperative position, coil *C* bears upon part *B*, but is clear of part *A*. As in the previous example, the coil is brought into contact with member *B*, not directly but through the intermediary of stops *M* and *R*. These stops, however, are not made in one piece with part *B*, but are loosely mounted on its hub. By driving wedge *S* between the two stops, the ends of the coil are turned in relation to each other to expand the coil against the inside of part *A*. Then the latter member drives the coil and part *B* as long as the stops are pressed against the edges of recesses *Y* and *X* on part *B*. Upon the withdrawal of the wedge, the friction ceases and the clutch is released.

Clutch member *B* of the design illustrated in Fig. 5 is keyed to the shaft but has a slight axial movement. Coil *C* bears upon part *B*, and may be expanded either like the design shown in Fig. 3 or by the method described in the following: One end of the coil is fixed by rivets *J* to part *B*, while the other end contacts with a wedge *P*, which by a movement to the left, expands the coil against the inside of the driving member *A*. In this type of clutch, power can be transmitted in only one direction.

Between part *B* and shipper *D*, to which the wedge is attached, there is a helical spring *O*. By moving the shipper toward the left, part *B*, through the medium of spring *O*, will be pushed toward driver *A* until the coil comes in contact with this part, after which part *B* will remain stationary, the final engagement of the members being secured by the action of wedge *P* on the end of the coil. The purpose of this arrangement is to reduce the effort required to engage the clutch to a minimum. In the clutch shown in Fig. 4 the coils must be expanded to such an extent that the clearance between them and the driving member is completely filled. In the design just described this effect is obtained almost immediately by the combination of the axial and expanding movements.

It will be realized that the coil clutch is better suited for heavy-duty transmissions than for use in the lighter classes of machinery. This is due to the large bearing surface in the coil clutch and also to the fact that the power transmitted assists in engaging the friction surfaces, thus securing, in effect, a certain measure of automatic regulation of power-transmitting capacity. Any slipping between the two mating surfaces tends to increase the pressure between them, so that there is little possibility of prolonged sliding of the friction surfaces on each other, except when the clutch is being engaged.

The multi-plate clutch, sometimes known as the "Weston coupling" after its original inventor, is one of the oldest and most effective forms of friction clutches. At first it was used primarily as a slipping coup-

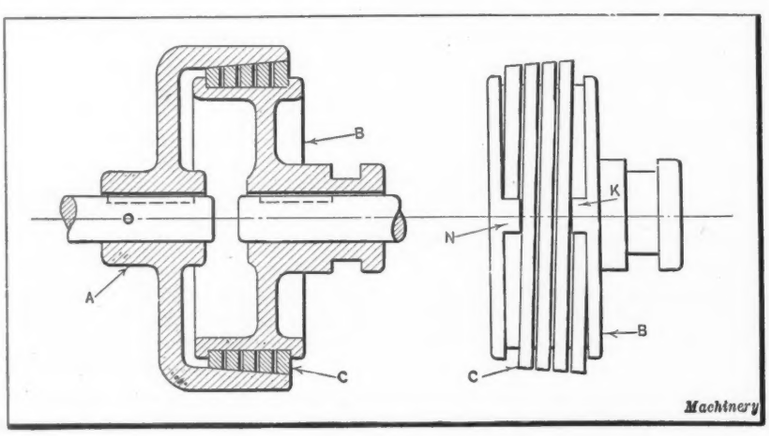


Fig. 3. Clutch Design in which a Single Continuous Coil serves as One Friction Member

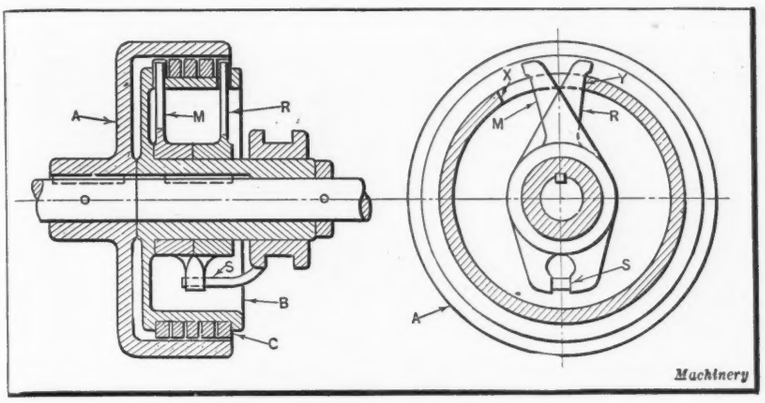


Fig. 4. Clutch which has a Coil with Parallel Cylindrical Surfaces

ling to provide a safety device for momentary overloads and thus prevent breakage of the mechanism to which it was applied. However, it was quickly realized that its effectiveness in this respect was equalled by its adaptability for transmitting heavy loads, though it can, with equal facility, be applied to medium and light drives.

A typical multi-plate clutch is shown in Fig. 6 in which driving gear *A* is to be coupled to shaft *B*. The gear has a sleeve *C* integral with it, on which are provided two or more feathers *D*. Shaft *B* is also equipped with similar feathers *E* and a shipper *F* by means of which, through any convenient form of lever device, axial pressure is applied to the gear. On the inside of sleeve *C*, and filling the space between the gear body and the shipper, are washers *G* and *H*, the former being keyed to the shaft by the feathers *E* and the latter to the sleeve by feathers *D*.

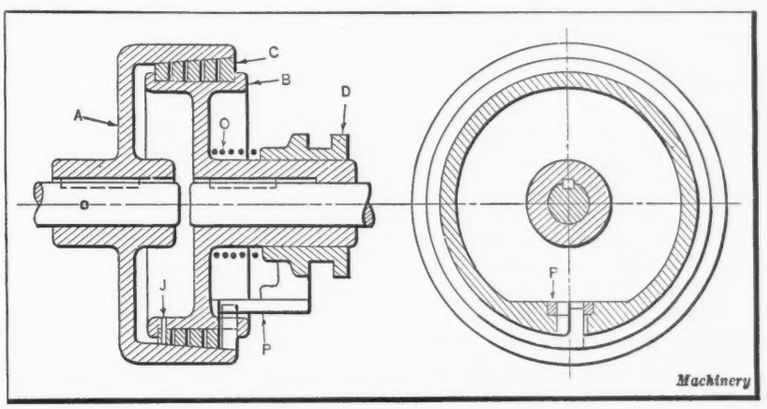


Fig. 5. Coil Clutch operated by a Combination of Expanding and Axial Movements

It will be seen that since each washer *H* is positively keyed to the gear and each washer *G* is just as positively keyed to the shaft to be driven, any axial pressure applied by shipper *F* will be more or less equally distributed over all the friction surfaces. Furthermore, the total capacity of the clutch will be equal to the sum of the capacities of each individual pair of mating surfaces. With any number of rings there is friction at twice that number of faces plus 1, so that with six rings, as in Fig. 6, the aggregate power-transmitting capacity will be thirteen times that of a single-plate clutch of similar dimensions, with the same axial pressure. Thus it will be seen that, other things being equal, all that is required to increase the capacity of a given clutch is to increase the length to accommodate additional plates.

In actual practice, the plates are often made alternately of wood and cast iron, so as to provide a higher coefficient of friction, though in smaller adaptations, as in the Ford transmission clutch for example, metal-to-metal friction surfaces are generally used. In the latter cases, the plates are generally sheet-steel stampings of comparatively thin material so that a large number of plates can be accommodated in a comparatively short length.

In designing a multiple-plate clutch there are three main principles which should be borne in mind: First, the internal and external diameters of the plates must not differ too widely or else there will be unequal wear of the faces. Second, the bore of the internally keyed plates *G* should be as large as circumstances will permit, so as to minimize the frictional resistance of the plates on the keys. The pressure on the keys, and consequently the frictional resistance as well, is directly proportional to the bore, so that the larger the bore, the less resistance there will be to sliding the plates on the keys. Third, adequate provision should be made for lubricating the friction surfaces so as to obviate the risk of the plates seizing when sliding on each other under pressure. For heavy-duty service at high speeds, the faces of the plates should be provided with radial oil channels fed from the center of the shaft by centrifugal force. If these factors are attended to and the bearing pressure on the friction surfaces is kept fairly low, say from 50 to 100 pounds per square inch according to the speed, there should be no difficulty in designing a satisfactory multiple-plate clutch of any capacity.

In conclusion, reference might be made to the Hele-Shaw clutch which is simply an adaptation of the Weston design. In this clutch, the plates, instead of being flat, are formed with an annular vee. The advantages of this construction are that the axial pressure required to transmit a given load is reduced by the wedging action of the vees, and the lubrication of the friction surfaces is more effective because of the slight clearance between the disk portions of the plates. The principle of this clutch is the same, however, and there would apparently be little difference in the over-all dimensions of equal-capacity clutches of the two types.

* * *

More good tools are ruined by improper treatment than by ordinary usage.

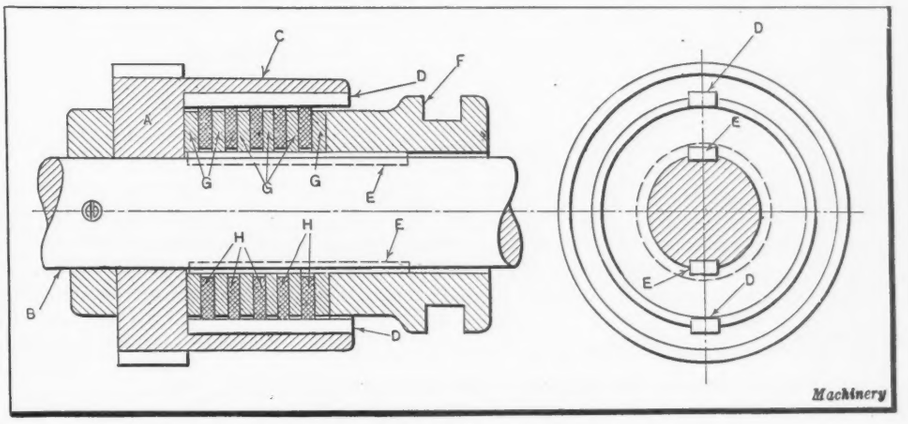
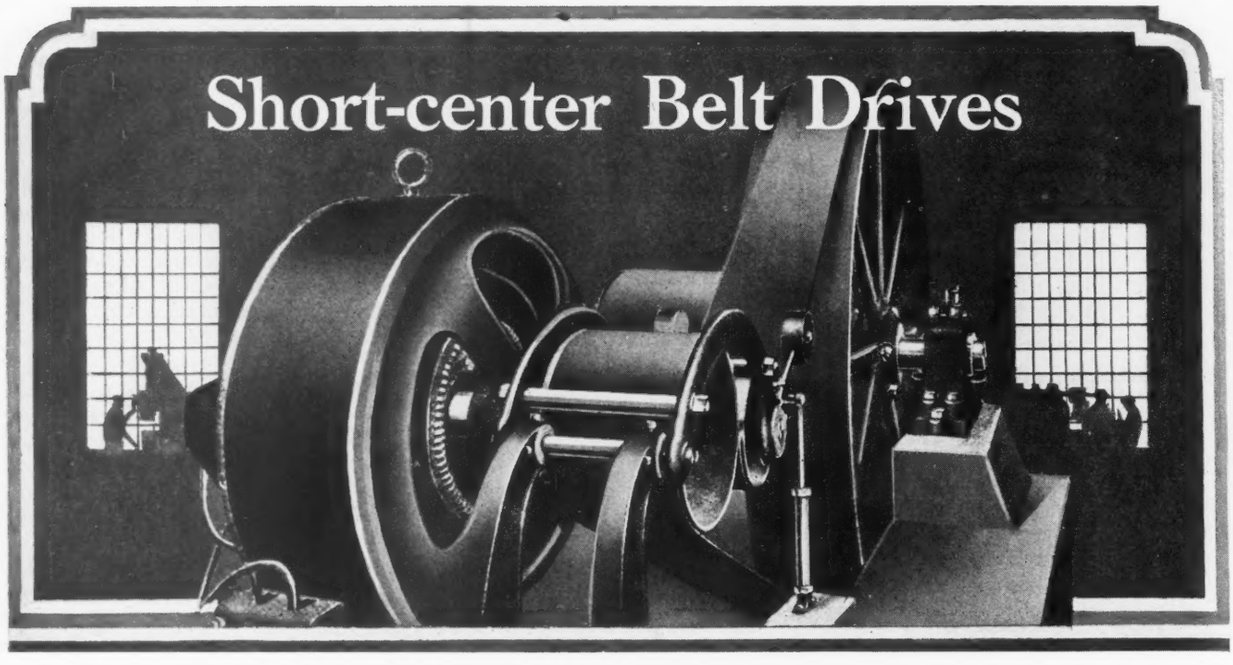


Fig. 6. Typical Multiple-plate Clutch used to drive Shaft B from Gear A

Short-center Belt Drives



Tension Rollers and their Bearings; the Arms, Equalizing Weights, Fulcrum Stands, and Shock-absorber—Last of Three Articles

By GUSTAVE A. FRENKEL

THE important features of modern short-center belt drives and calculations involved in their design, were explained in the first and second articles of this series. The various parts of short-center drives will now be considered, such as the tension roller, its supporting arms, the weights for adjusting the tension, the important bearings, and other elements.

Tension Rollers and Their Supporting Arms

A good grade of cast iron is the most suitable material for the tension roller. This roller must be truly cylindrical, and therefore it may be well to take the finishing cut after the roller has been placed on its shaft. The tension roller should be made heavy in order to reduce the sizes of the equalizing weights. This, however, applies to overhung types of drives only. For underhung drives, where the dead weight has to be added to the effective weight, the tension roller naturally should be made as light as possible. As tension rollers usually run at high rim velocities, they should be well balanced. For smaller sizes, it is good practice to use a plate center and turn the roller roughly on the inside. Tension rollers should always have a straight face.

The arms usually are made of cast iron and have either a U-, I-, cross-, or oval-shaped section. The oval section is the most suitable. In calculating the strength of the arm, two forces have to be considered. Referring to Fig. 17, Q is the weight acting on the lever. The maximum bending moment due to this weight is in a plane ab tangent to the hub and is equal to $\frac{Q \times l}{m}$. The magnitude of force T may be determined as explained in the second article of this series in connection with Fig. 16, T being equal to OC. Though this force manifests itself as a tensile stress, it subjects the arm to bending, as will be seen by referring to Fig. 17. The maximum bending moment due to this force T is at cd and is equal to $\frac{T}{2} \times n \left(\frac{T}{2} \text{ for each arm}\right)$. In designing the arm, it should be borne in mind that, from a manufacturing viewpoint, it is of great advantage to have the hub faces, as well as the bosses for the tie-rods, in line, so that they can be planed or milled in one operation and the arms put together for boring. This will give the accuracy required for a smooth running drive. The radius of the curved arm should be made 0.5125 times the span

Tension Roller Bearings

The selection of the proper type of bearing for the tension roller of a short-center belt drive is of great importance. An unsuitable bearing not only causes heating, but may also cause the drive to fail entirely. The least twisting in the arms, which will occur if the tie-rods are not stiff enough to form a rigid frame, will have an injurious effect on the bearings. This possibility increases with the width of the belt, especially when the span of the arms is large.

The bearings of the single-arm style of support will be considered first. For this style, the pulley is overhung, and ordinary twisting of the arm has no effect on the bearing. The single-arm design, however, is used for light service only and the requirements are not so exacting. A very satisfactory type of bearing for a single-arm support is shown in Fig. 18. It consists in the main of a self-lubricating bushing, fitted tight into the hub of the arm. The cover in the front of the arm forms a pocket into which the oil is poured and from which it flows through the holes i into the oil-chamber, to be absorbed by cotton twist and finally delivered to the journal. The cotton is kept in position by ribs cast on the bushing in the form of a spiral.

Another type of bearing for the single-arm design is illustrated in Fig. 19. This is superior to the one shown in Fig. 18, provided the ball bearings are of sufficient size and are kept well lubricated. In Fig. 20 at A is shown a ring-oiling bearing arrangement to be used on double-arm supports. The hub of the arm is provided with an oil-chamber. The bearing itself is formed of two parts, with ample space between them, allowing a ring to be placed on the shaft. A pocket within the gland toward the pulley keeps the oil from running out, and is provided with several small holes leading to the oil-chamber. On the top of the arm is an opening large enough for inserting the ring. Paper packing between the flanges renders the bearing oil-tight. This type of bearing requires a rigid connection of the arms, and should be used in connection with narrow belts only. An

arrangement with ball bearings is shown at *B* in Fig. 20. This type of bearing has given satisfactory results with the heaviest drives. At least medium type ball bearings should be used. While the ball bearing in one arm can be arranged as shown in the illustration, the opposite side should be provided with sufficient clearance sidewise, so as to allow a floating of the outer ball race.

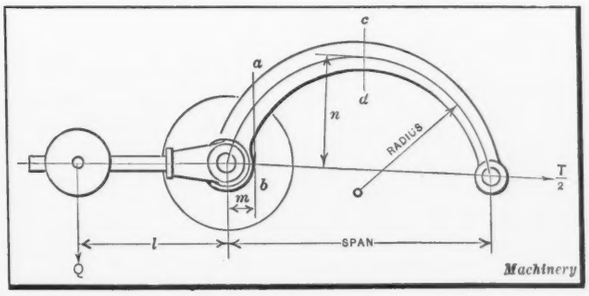


Fig. 17. Factors involved in designing Arms for Tension Roller

The equalizing weights are usually of circular form, with a core large enough to allow easy shifting on the levers. The set-screws should be provided with check-nuts, to prevent a loosening and shifting of the weights while the drive is in operation. As a rule, the equalizing weights should not total more than one-third the effective weight *K* which is determined as explained in the second installment of this series in connection with Fig. 16. If the weights on the extended levers are too heavy, this will cause a flapping of the belt. When necessary, an additional weight can be added to the tension roller by making the rim heavier, in order to comply with the foregoing rule.

The curving of the upper part is done for two reasons: First, to avoid interference with the tie-rod when the arms are reversed, as is done in case the tight strand of the belt is on the top; second, to clear the motor base when two stands have to be used on account of a wide belt. These stands are made either central (design *A*) or right- and left-hand (design *B*). The central stand is used when the belt does not exceed 15 inches in width; it has a long hub with four set-screws on each end and a cored hole about ½ to ¾ inch larger than the diameter of the fulcrum shaft. This arrangement (four-point contact) has the advantage that the arms can be adjusted to the right position if the stand has not been lined up precisely on its concrete base. The right- and left-hand stands are used when the belt is over 15 inches wide, and this type should be set close to the arms.

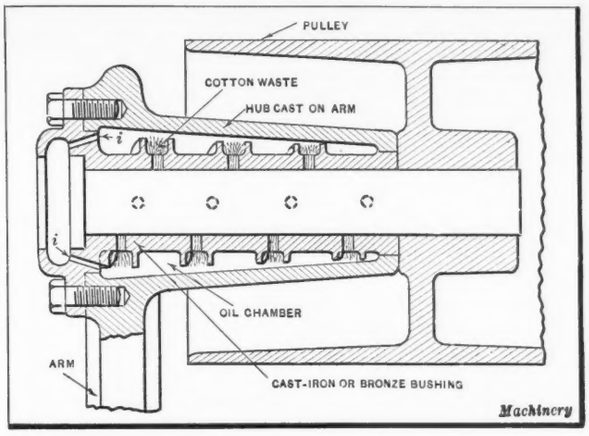


Fig. 18. Type of Bearing adapted for Single-arm Support

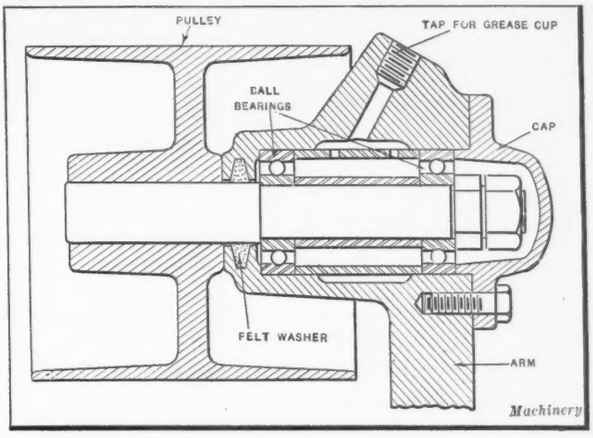


Fig. 19. Another Design of Bearing for Single-arm Support

Fulcrum Stands and Their Arrangement

The method of determining the proper location of the fulcrum has been explained in connection with Fig. 13 of the first article in this series, and now the various kinds of stands will be described. The stand for the single-arm support (Fig. 6 of the first installment) has a cast-iron base in the form of a column, with a steel shaft pressed in. This base should be of medium height, as the cross-head can be adjusted vertically, thus placing the fulcrum in any position desired. The stand for a single-arm support can be arranged either on the floor, the wall, or the ceiling, as it is intended for the smaller belts only.

The stands for the double-arm overhung support are shown at *A* and *B*, Fig. 21. The stands for the double-arm underhung support and for the drive between the centers are illustrated in Fig. 22. They are, in general, of the same construction as the stands for the double-arm overhung support, with the exception that they are not curved. The central stand *A* is for narrow belts and the right- and left-hand design *B* is for wider belts. These stands are subjected to heavier stresses than those for the overhung arrangement, and should be made very strong.

The shock-absorber employed in connection with a short-center belt drive consists principally of a smooth steel tube *a* (Fig. 23), closed on both ends, in which a piston *b*, fitted with a leather cup, is free to slide up and down. The lower end of this cylinder is pivoted to a bracket which is bolted to its foundation. The cap on the upper end, through which the piston-rod extends, is equipped with a stuffing-box. Near the upper and lower ends of the tube, air cocks *c* and

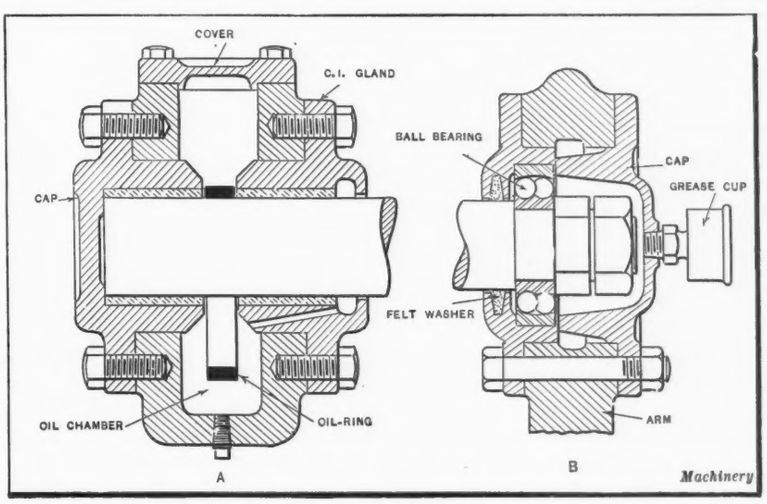


Fig. 20. Ring-oiling Bearing, and Ball Bearing for Double-arm Supports

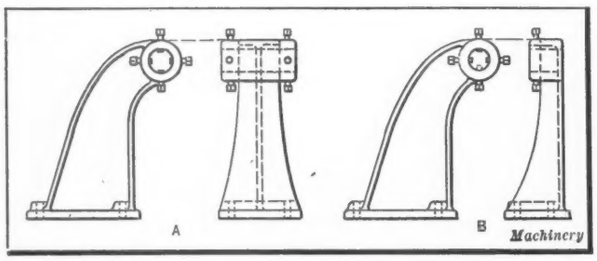


Fig. 21. Fulcrum Stands for Double-arm Overhung Supports for Tension Rollers

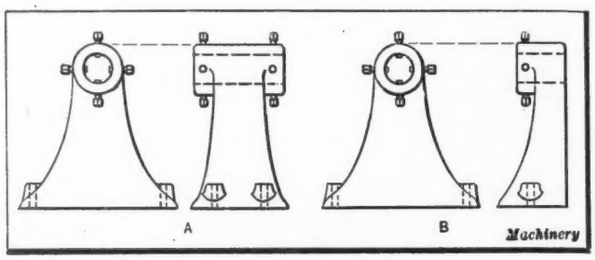


Fig. 22. Fulcrum Stands for Double-arm Underhung Supports for Tension Rollers

d are provided for the regulation of the expansion and compression of the air below and above the piston. The upper end of the rod is pivoted to a bracket attached to the lever that carries the equalizing weight. The arrangement of the leather cup is such as to allow the air to pass when the piston moves downward, but it is pressed against the inner surface of the tube by the compressed air during its upward movement.

The function of the shock-absorber is as follows: When a heavier load is suddenly applied to the belt at intervals, the elongation and contraction of the belt causes a rapid fluctuation of the tension roller, which, owing to these sudden changes in the tension of the slack strand, would be thrown off the belt if no means were provided to increase automatically the effective weight. The shock-absorber holds the roller in position in a simple way. As the air is allowed to pass between the leather cup and the inner surface of the tube, when the piston is forced downward, there is no resistance and the roller can drop freely in accordance with the momentary elongation of the belt due to sudden load changes. But when the piston is forced upward, the compression of the air above the piston and the expansion below it cause a resistance, the magnitude of which may be regulated by means of the air cocks *c* and *d;* consequently the tension roller is kept on the belt. It has been found that tubes of the following inside diameters meet practical requirements: 2½ inches for drives up to 50 horsepower; 3 inches for drives up to 250 horsepower; 4 inches for drives up to 600 horsepower; 5 inches for drives above 600 horsepower.

Shock-absorbers should be employed whenever a heavily pulsating load is carried by the belt, as in driving air compressors, ball and tube mills, excavators, crushers, piston pumps, etc. Two shock-absorbers are used, these being one on each side of the belt so that the tension roller frame will not be subjected to a twisting action. These shock absorbers compensate effectively for any pulsating load; assure a smooth running of the drive, and prolong the life of the belt. They increase the belt stresses only at intervals when shocks or sudden loads occur while the air resistance is added to the effective weight. The normal belt stresses are restored instantly after absorbing the shocks.

The practice of some engineers of allowing for 30 per cent to 50 per cent overload for certain machines in figuring belt drives is, from an economical viewpoint, objectionable, because the rating of machines, as given by manufacturers, represents the peak load already. This addition of from 30 to 50 per cent to the power rating given by manufacturers not only puts an unnecessary and excessive stress on the belt, due to the much higher effective weight placed on the slack strand, but also increases the bearing pressure, causing excessive friction load, and decreases the efficiency of the belt drive. It has been shown previously that the highest efficiency of a belt drive is obtained with a certain effective pull per square inch of belt. This effective pull is reduced considerably by increasing the belt area beyond necessity; hence the drive will work under unfavorable conditions, if such practice is adopted.

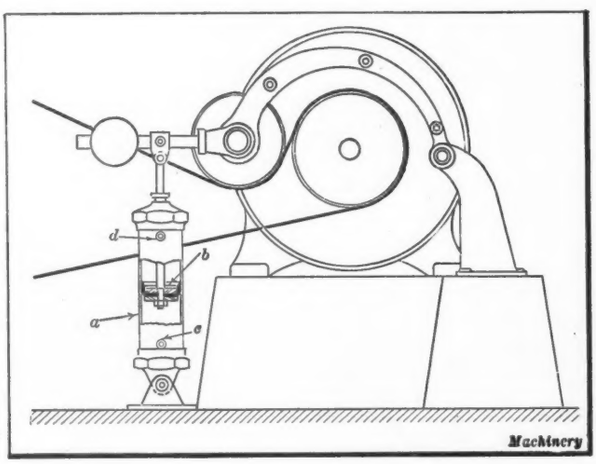


Fig. 23. Shock-absorber applied to Tension Roller for Drive subjected to Sudden Load Fluctuations

[These articles on Short-center Belt Drives will be supplemented by two others from the same author. One of these is entitled, "Belting Materials" and the other, "Rubber Belting." In connection with the latter, data and formulas required in designing rubber-belt transmissions for short-center drives will be given—EDITOR].

* * *

ADVERTISING STANDARDIZED PRODUCTS

In response to requests for a definition of policy in regard to the use of references in advertising matter to standards approved by the American Engineering Standards Committee, the committee has formulated its policy in the following resolution:

"Resolved, that in the opinion of the American Engineering Standards Committee the use, in the advertising of products which comply with specifications and other standards approved by the committee, of proper references to such standards, is advantageous and makes for industrial economy; accordingly, the committee desires to encourage the use of such references in trade catalogues and other advertising media, but the committee will in no case pass upon the merit of products, or upon their compliance with specifications or other standards, which questions it will leave to the commercial and legal agencies equipped for such work."

* * *

A special process for softening cast iron is said to make it possible to obtain a heat-treated metal which is as ductile as steel. The process consists in heating the iron to a temperature slightly above 1600 degrees F., while it is protected in a muffle surrounded by a gas flame, but open at the top. As soon as the cast iron reaches the proper temperature, the muffle with its contents are removed from the furnace and allowed to cool in the open air, the whole operation requiring about forty-five minutes. It is said that a thin bar of cast iron treated in this manner may be coiled into a spiral. It is also said that samples of this annealed cast iron have been left for several months without changing shape by warping, while unannealed castings of the same metal and made from the same pattern have shown considerable warpage

MAKING THREAD GAGES

By CARROLL D. EDGAR
Instructor, Georgia School of Technology, Atlanta, Ga.

Thread gages hold an important place among the gages employed in the machine-building industry and much could be written about the different methods used in their manufacture. This article concerns their manufacture on an engine lathe only. The three factors that have been carefully considered are accuracy, quality, and cost. A gage made of tool steel is preferable, but the cost is much greater than that of gages made from cold-rolled steel. Both kinds of steel can be used, however, with very satisfactory results.

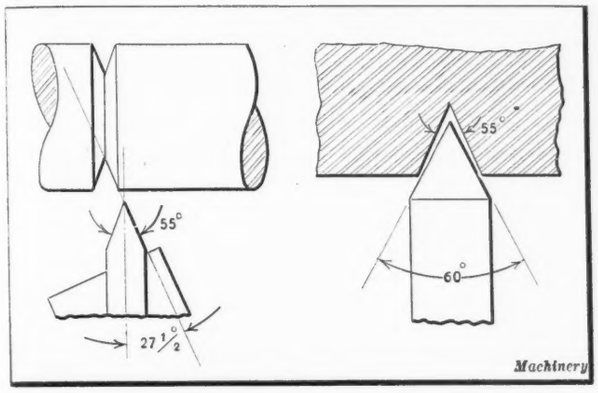


Fig. 1. Diagrams showing Methods of rough- and finish-threading Gages

The use of cold-rolled steel is strongly recommended where production is the main factor to be considered, the advantage being that it is easy to machine, the cutting tools last longer, and the production time is less. It is necessary, of course, to carburize cold-rolled steel so that it can be hardened. When the carburizing is properly done, the resulting product is very satisfactory. In the method to be described, the first operation is that of rough-turning the thread gage blanks from rough stock, allowing 0.025 or 0.030 inch for finishing.

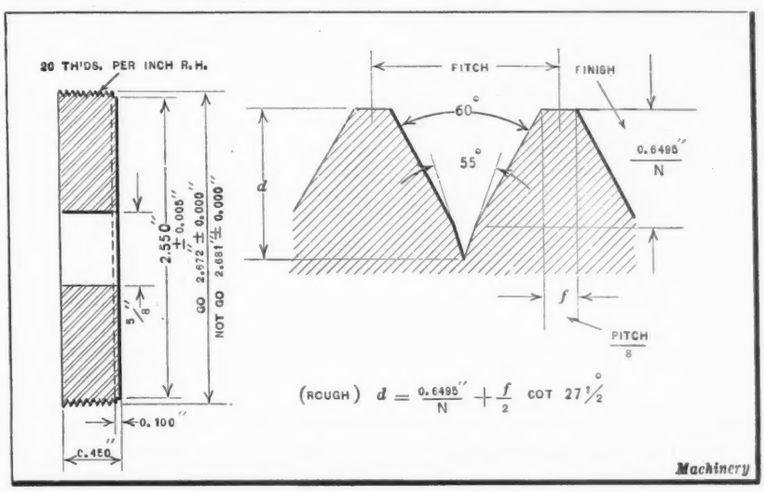


Fig. 2. Specifications for a U. S. Standard Thread Gage

In the second operation, the rough-turned blanks are thoroughly annealed. The effect of the annealing process is to relieve the internal stresses, and it is accomplished by heating the blanks to a cherry red and then slowly cooling them in dry lime or sand. In the third operation, the blanks are finish-turned to size, and allowance for shrinkage being made, which must be determined by experiment. The fourth operation is that of rough-threading the gages. This is the operation to which particular attention will be called, as the methods here described are somewhat different from those ordinarily used. Assuming that the thread angle is 60 degrees, the tool employed for the rough-threading operation is ground to an included angle of 55 degrees, as shown in the diagrammatic view at the left-hand side of Fig. 1. The top of the tool is perfectly flat, and a cutting angle of 6 to 10 degrees is allowed.

This threading tool is placed in a compound rest, as shown in Figs. 1 and 3, and is fed in at an angle of 27½ degrees so that the left-hand side of the tool cuts the thread groove. The depth of the thread is calculated for a regular 60-degree thread angle, an allowance being made for subsequent operations, as indicated by the formula for d in Fig. 2. The surface cutting speed employed in threading gages like the one shown in Fig. 2 is about 11 feet per minute. Sperm oil should be used as a cutting compound, but if this is not available, a good grade of lard oil may be employed. For a roughing cut with the 55-degree tool, a feed of about 0.003 inch is used so that approximately ten cuts will be required for the roughing operation.

The fifth operation—that of finish-threading—is performed with a threading tool having an angle of 60 degrees and the usual side cutting angle. This tool must be very accurately positioned in the toolpost. A magnifying glass should be used to make sure that the 60-degree tool is tangent to the 55-degree thread, as shown in the view at the right-hand side of Fig. 1. This tool is fed straight in, so that it will cut on both sides at the same time. Cuts of about the same depth as those used for rough-threading are employed until within a few thousandths inch of the required depth. The feed is then gradually reduced from 0.0015 to 0.0005 inch for the last few cuts. Usually about twenty-five cuts are required to complete the finish-threading operation.

The difference between this method of threading and the usual one is that the point of the 60-degree finishing tool is not required to remove any metal, and therefore cannot "dig in." The 55-degree tool does the roughing out, so that the 60-degree tool has but a very small amount of metal to remove, and a fine finish, as well as a high degree of accuracy, is obtained. After completing these operations, the gage is ground and lapped in the usual manner.

* * *

A report prepared by the National Industrial Conference Board shows that the highest paid trades in the United States are those engaged in newspaper and magazine production, the average weekly wages in the printing industry having more than doubled since 1914. The iron and steel industry holds the second place among the country's workers, the men working in automobile factories coming third.

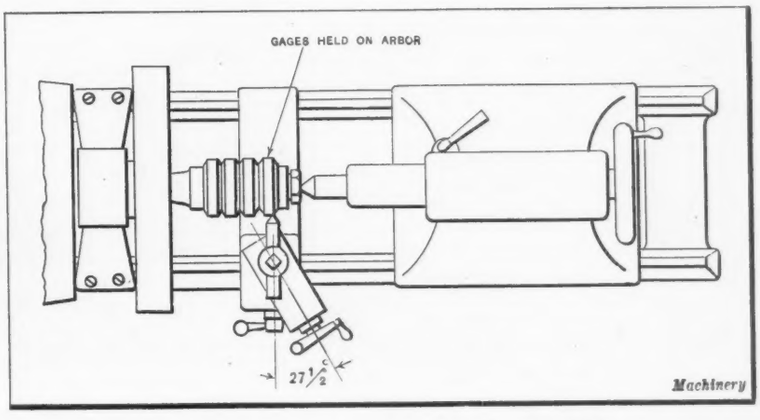


Fig. 3. Lathe set up for rough-threading Four Gage Blanks

Work of the Bench Lathe

Examples from Practice, Illustrating Methods of Using Various Tools and Attachments for Precision Toolmaking and Manufacturing Operations—First of Two Articles

By FRANKLIN D. JONES

THE variety of work that comes within the usual range of the bench lathe is exceptionally large, because this type of lathe is used widely both for the interchangeable manufacture of small parts and for fine precision tool and instrument work. This general application of bench lathes has resulted in the development of many tools and attachments for adapting such lathes to the varied requirements indicated by the examples to follow.

Although the term "lathe" ordinarily implies turning operations, bench lathes with their attachments are commonly used for many other operations, such as grinding, milling, etc. Some of these attachments are intended primarily to permit handling a larger variety of operations, whereas others are designed more especially for the rapid production of duplicate parts, as, for example, when the arrangement is such that a succession of tools may be applied rapidly for finishing duplicate parts on a quantity basis. Bench lathes are not only used throughout the machine-building and toolmaking industries, but also for all kinds of model and instrument making, as well as for experimental work generally.

The work for which bench lathes are commonly used may be divided into several general classes. One of these includes precision work requiring a machine that may readily be set up, and that will have the features of accuracy and speed of manipulation which can only be obtained with the bench lathe. Then there is the modern application of bench lathes in interchangeable manufacture, as applied to both small and large quantities, with production rates often comparing favorably with less accurate methods.

A third group includes precision work on parts requiring such a variety of operations that bench lathes, with their provision for rapidly changing tools and attachments, provide the only practical method. Finally, we have the use of the bench lathe for producing small parts that might be handled readily by either turret lathes or automatic screw machines were it not for the extreme degree of precision necessary. The examples of work that follow illustrate the uses of different attachments and show, in a limited degree, the unusual variety of work, as well as the general character of the operations performed on bench lathes.

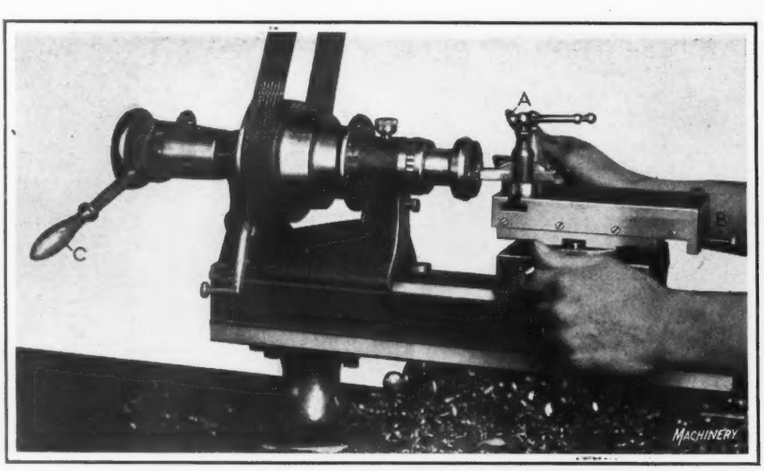


Fig. 1. Facing and Counterboring Operation for which Rack-and-pinion Type of Slide-rest is used

Different Types of Tool-slides and their Use

For certain operations on bench lathes, it is preferable to operate the tool-slide by a hand-lever instead of using an ordinary feed-screw, on account of the more rapid movement obtained. The connection between a hand-lever and slide may be direct or through a pinion meshing with a rack attached to the slide. If the manipulation of the ordinary feed-screw is too slow and a direct-acting lever does not give quite the feeding power needed, then a hand-lever which acts through the medium of a rack and pinion is the best combination.

Fig. 1 shows the use of a rack-and-pinion slide-rest on a lathe built by the B. C. Ames Co., Waltham, Mass., for facing and counterboring brass rings. The ring is held in a collet chuck, and the outer edge is faced by an inverted tool in the rear position, this tool having a broad straight cutting edge. The tool in the front toolpost is set for the counterboring operation. The upper slide is moved forward by a hand-lever *A* to a point determined by the position of the positive stop-screw *B*, at the end of the slide. It will be noted that this slide-rest attachment has a cross-slide and also a swivel adjustment for angular work. The lever chuck-closer operated by lever *C* provides a rapid means of opening and closing the chuck, which is particularly important when the cutting time is short, as in this case, and frequent insertion and removal of the work are necessary.

Another application of the rack-and-pinion slide-rest is shown in Fig. 2, which illustrates an Ames lathe arranged for turning a shoulder on the end of a dial gage spindle. This reduced end must be very accurate, smooth, and concentric with the remaining surface of the rod. Two circular cutters *A* and *B* are used. Cutter *B* at the rear is inverted, and both cutters are located close to a guide bushing *C*, through which the rod passes. As bushing *C* remains in a fixed position relative to the cutters, concentric shoulders are obtained.

Fig. 3 shows the tool-slide on a lathe

made by the Stark Tool Co., Waltham, Mass. This tool-slide has a lever-operated top slide and a screw-operated bottom slide with a dial graduated to thousandths of an inch. This arrangement is intended for comparatively light cuts, particularly when rapid manipulation is essential. The upper slide may be inclined for angular work, as illustrated by the application shown. Such slides are used for boring, facing, recessing, and sometimes in connection with grinding operations.

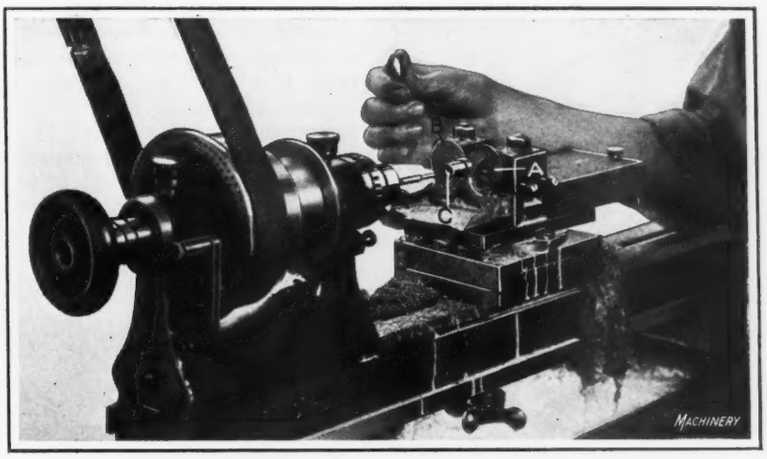


Fig. 2. Accurate Shoulder-turning Operation, requiring Guide Bushing and Front and Rear Tools

Use of Tailstock Spindle as Tool-holder

In bench lathe practice, the tailstock is frequently used as a means of holding and feeding various classes of tools. Tailstocks for bench lathes are made in several different forms. The type intended primarily for supporting one end of centered work is designed along the general lines of the well-known engine lathe tailstock. Then there is a lever-operated tailstock (Fig. 4) for drilling, reaming, counterboring, and similar operations.

Another form is operated through a rack and pinion in conjunction with a hand-lever (see Fig. 5). The cross-slide adjustment provided in this case is useful for recessing, facing, and counterboring. The "half-open" tailstock, Fig. 6, is employed for light operations such as drilling, reaming, lapping, and the cutting of very small threads with taps or dies, while the revolving-spindle tailstock (Fig. 7) is applied to certain drilling operations. The "sliding" or "open" tailstock is similar to the half-open design, except that it has full or complete bearings. The spindle has a knob at one end and is moved by hand the same as the spindle of a traverse grinder.

Operation Employing Lever Type of Tailstock

Fig. 4 shows the use of a plain lever tailstock and double slide-rest on an Ames bench lathe, which is being used to make small brass bushings. The tin box on the bench contains quite a number of these bushings. The stock used is 5/16-inch brass rod, and the sequence of operations is as follows: The stock is pushed out against stop *A*, held in the rear tool-block; a hole is next drilled through the center of the bushing, using the lever tailstock; a shoulder is then formed on one end of the bushing by a circular forming tool *B* held in the front tool-block, and the same tool severs the finished bushing from the rod.

An interesting feature of this job is the method of obtaining the extreme accuracy required for the shoulder diameter. Ordinarily the position of the cross-slide for obtaining a given diameter is controlled with sufficient accuracy by the engagement of lug *C* on the slide with one of the adjusting stop-screws *D*. Although such stop-screws are positive, it is well known that there is always a slight amount of flexibility which may result in minute variations, owing to the fact that the workman does not exert exactly the same pressure against the stop each time a part is turned. Such variations are negligible for ordinary operations, but as extreme accuracy is required in this case, a dial gage *E* is used in conjunction with a positive stop to eliminate even the slight pressure-variation errors mentioned.

This gage is held in a fixed position, and is so located that the slide comes into contact with the gage point at the same time that the cross-slide lug encounters the stop-screw; the workman then exerts just enough pressure on the hand-lever to swing the hand of the dial gage around to the zero position. This shows that the shoulder has been turned to the exact diameter required. In this simple manner a high degree of accuracy and uniformity is maintained.

Broaching by Using Rack-and-pinion Tailstock

The use of a bench lathe for broaching is not a typical or common application, although the example illustrated in

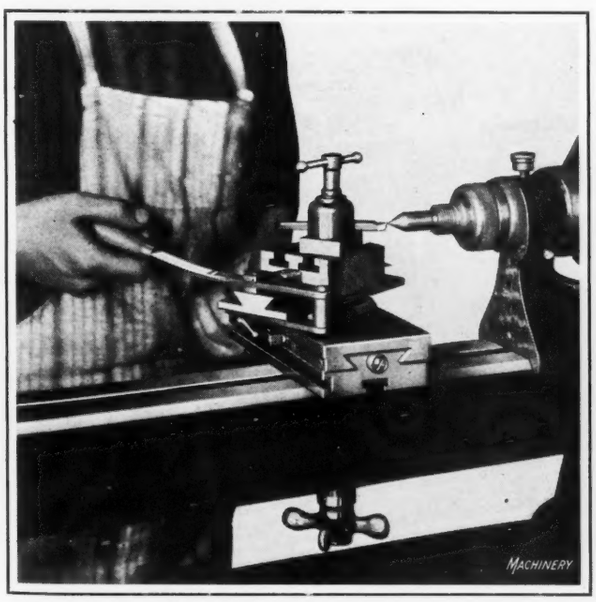


Fig. 3. Use of Direct-connected Hand-lever for Rapid Manipulation of Tool-slide

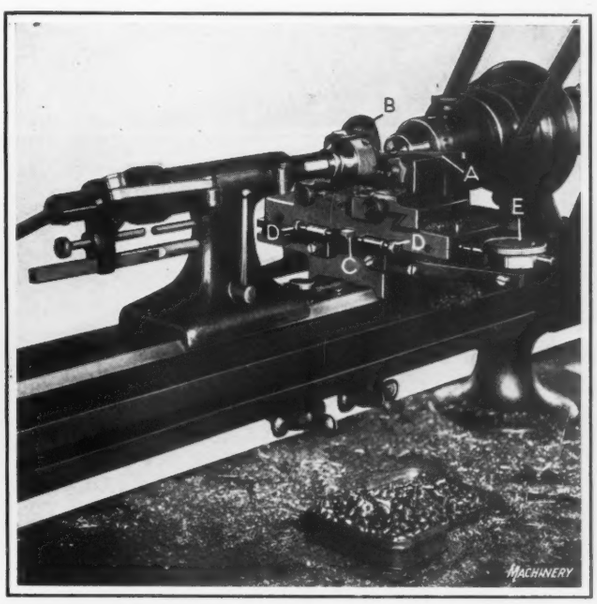


Fig. 4. Lever-operated Tailstock, for Drilling, Reaming, Counterboring, and Similar Operations

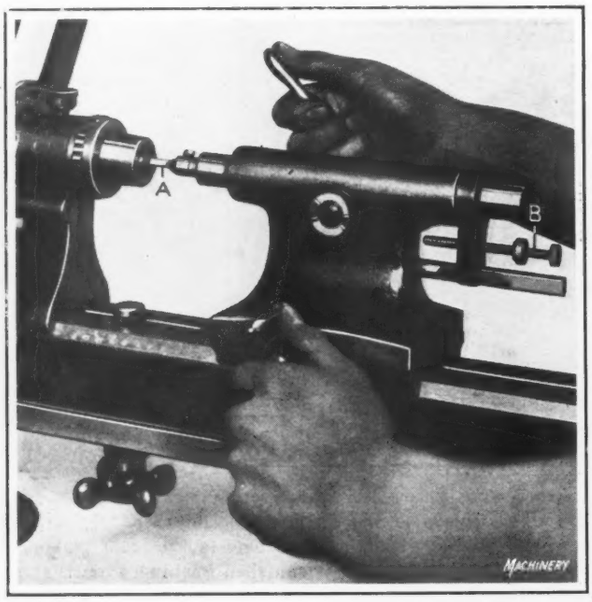


Fig. 5. Broaching on Bench Lathe by using Rack-and-pinion Tailstock

Fig. 5 shows how such an operation is easily and accurately performed. Incidentally, this operation might prove difficult if attempted by some other method. The work is that of broaching hexagon holes in bench lathe collets which are to be used for holding rods of hexagonal shape. These collets are first drilled to remove as much metal as possible prior to broaching.

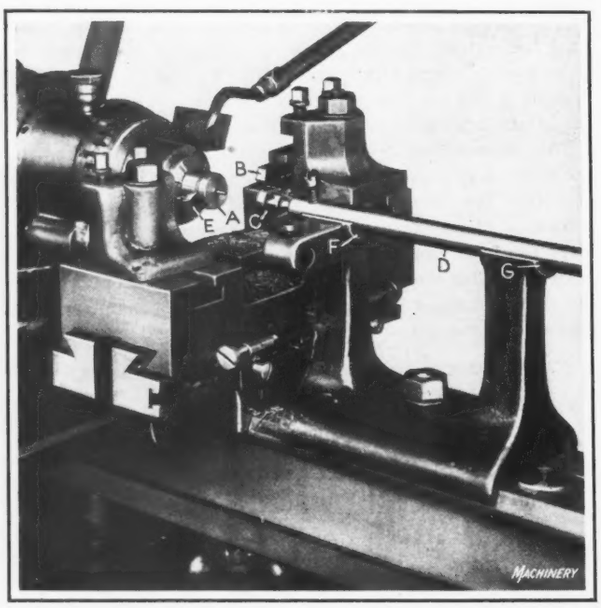


Fig. 6. Example illustrating Use of Half-open Tailstock

The Ames lathe used is equipped with a rack-and-pinion tailstock, the spindle of which carries the end-cutting broaching tool. This tool has two cutting edges, representing two sides of the hexagonal hole. The tool *A* is operated by the pinion hand-lever, and it is fed laterally after each cut by using the cross-slide of the tailstock. In this simple manner two sides of the hexagonal hole are formed. The work is then indexed, this movement being controlled by an index-pin, which engages holes in the cone pulley flange. This broaching is done before splitting or slotting the collet. The rack-and-pinion fixture may be used for various other operations, such as drilling, counterboring to exact depths, facing, recessing, and similar work. The adjustable stop-screw *B* is used for regulating the depth of a hole or counterbore, or the location of an inner recess.

Application of Half-open Tailstock

An operation that illustrates one of the numerous uses of the half-open tailstock is shown in Fig. 6. The part *A* being made is a small screw having a large button-shaped or rounded head of the form used as contact points on some of the Ames dial indicators. The threaded section is 0.085 inch in diameter, and it has 64 threads per inch. The diameter of the head is ¾ inch. Inverted tool *B* at the rear of the cross-slide first turns the ¾-inch stock down to the screw size and also forms a narrow shoulder under the head. Die *C* is next used to cut the thread. This is done easily and quickly by merely pushing spindle *D* forward, while the lathe spindle is revolved by hand. The combination forming and cutting-off tool *E* at the front is now used to form the rounded head and sever the finished part from the bar.

Fig. 7. Drilling Small Holes by using Tailstock of Revolving-spindle Type

As the tool-holding spindle used with half-open tailstocks merely rests upon two open bearings *F* and *G*, it may quickly be replaced when the operation requires two or more tools. Each tool needed for a series of operations is attached to a separate spindle, so that one after the other may readily be placed in the working position. Another im-

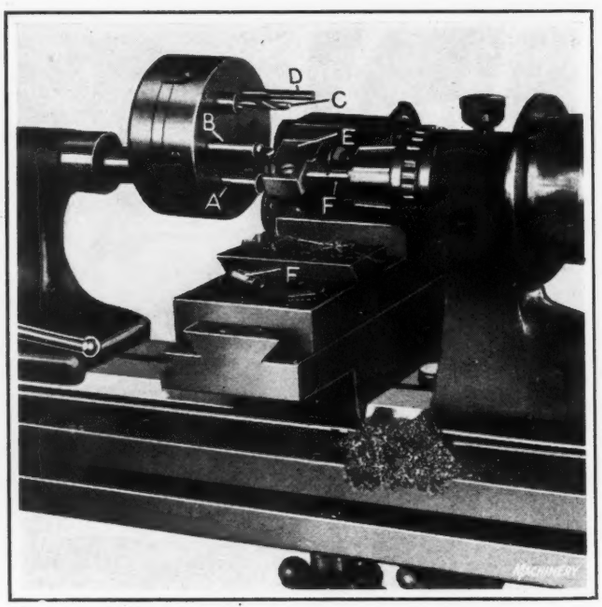


Fig. 8. Small Turret Fixture of the Tailstock Type

portant advantage is that these light, hand-controlled spindles provide the sensitive control so essential in drilling or tapping very small holes, and for other precision work.

Revolving-spindle Tailstock

In installing bench lathes, the countershaft pulleys are usually arranged to give headstock spindle speeds varying from about 250 up to 1100 or 1200 revolutions per minute. This range of speeds covers all ordinary requirements so far as the main spindle of the lathe is concerned. Certain tools, however, such as drills or laps require much higher speeds, which are obtained by a special drive to the spindle of whatever attachment is used.

The traverse grinder, which is used for both grinding and lapping, is one attachment which must run at very high speeds, and the revolving-spindle tailstock is another. A Stark lathe equipped with such a tailstock is shown in Fig. 7. The tailstock spindle is driven from the grinding countershaft by a small round belt, and the speed for light drilling is sometimes as high as 10,000 revolutions per minute. As the illustration clearly shows, a hand-lever is used for feeding the spindle and drill. The latter, in this particular case, is held in a chuck. The work and drill are rotated in different directions to insure straight drilling.

This form of tailstock is especially recommended for drilling deep holes straight and concentric, particularly small holes 1/32 inch in diameter or less. One form of revolving-spindle tailstock differs from the design just referred to, in that it has a knob at the end of the spindle instead of the hand-lever type of feed. This arrangement, which is practically the same as that of a traverse spindle grinder, is intended especially for very light work.

Use of Turrets on Bench Lathes

Whenever a succession of tools must be used for operations such as spotting, reaming, drilling, counterboring, etc., some form of turret attachment is commonly used. One type is held by the regular tailstock, and the tools, which are held parallel to the lathe spindle, are brought around to the working position by rotating the turret about a horizontal axis (see Fig. 8). Another form of turret indexes about a vertical axis (Figs. 9 and 10), and is mounted upon a slide, the arrangement being similar to that of a turret lathe or hand screw machine. Turrets are particularly useful in making small screws, studs, bushings, sleeves, pins, pivots, and similar parts. The turret may be advanced and withdrawn either by means of a direct-acting hand-lever or by a lever operating through a rack and pinion.

Fig. 8 illustrates the use of a small turret fixture of the tailstock type, for an operation on an Ames bench lathe. The work is that of turning small brass sleeves *F* from 9/32-inch rod. This sleeve is turned to two diameters on the outside, and is drilled and reamed to two inside diameters, within very close limits. The bar of stock is first moved out against stop *A* which governs the length projecting beyond the chuck; the end is then spotted or centered by tool *B*, which is followed by drill *C* and reamer *D*. The outside is turned by box-tool *E* which has a pilot that enters the hole just reamed, thus steadying the tool and insuring concentric outer and inner surfaces.

The circular type of cutting-off tool, which next comes into action, is mounted on the front cross-slide, and the latter is operated by a hand-lever through a rack and pinion. The turret is indexed by hand to locate the successive tools in line with the lathe spindle axis. This indexing is done by turning the tool-holding plate of the turret, relative to the baseplate attached to the tailstock spindle. The various locations of the turret are controlled by a pawl and index-plate located within the body of the turret. The lever type of tailstock is used for this operation, as well as the lever chuck-closer, thus providing rapid operation for both turret and chuck.

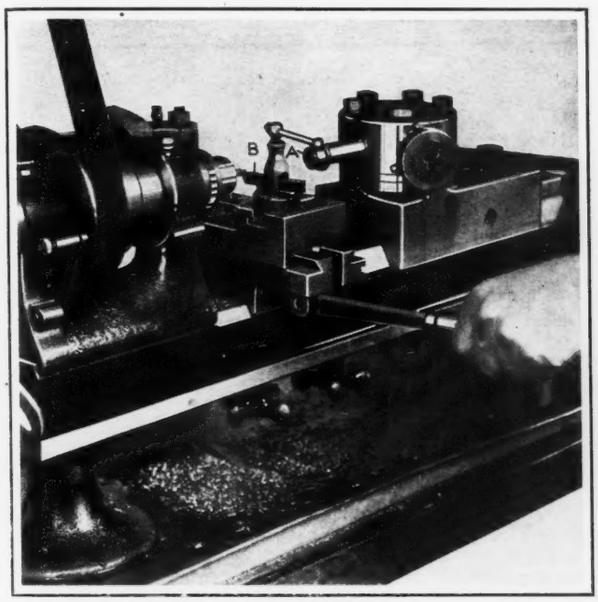


Fig. 9. Turret Attachment used for Larger Classes of Bench Lathe Work

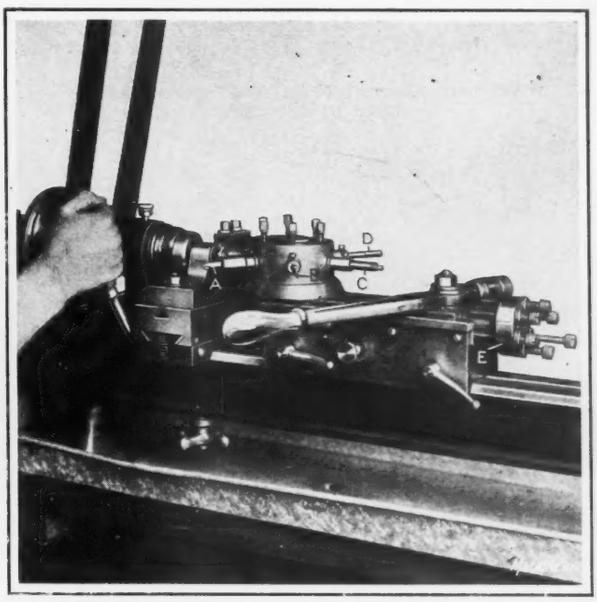


Fig. 10. Another Application of a Bench Lathe Turret

Fig. 9 illustrates the application of the Ames vertical or "large" turret fixture. This turret is supported by a long slide mounted directly upon the bed, and it is used for the larger classes of bench lathe work. The particular job shown is that of making steel gage handles from ¼-inch stock. The rod is first located against stop *A*. Tool *B* is then used to turn a shoulder at the end, after which the die is brought around to its working position and the thread is cut; then, after pushing the rod out against another stop located diametrically opposite stop *A*, the handle is severed from the bar by a cutting-off tool at the rear of the slide. The turret-slide is operated by a hand-lever, and the turret indexes automatically at the rear end of its stroke. The lever-operated chuck and cross-slide are also used for this operation.

Another operation representing a typical application of the turret in bench lathe practice is shown in Fig. 10. The Stark bench lathe shown is being used for producing steel slide-rest bushings. These bushings have two external diameters of 7/16 and 9/16 inch, respectively, and a counterbore at one end of the bushing hole. The illustration shows the turret stop in the position opposite the spindle. After feeding the stock against this stop, the smaller diameter of the bushing is formed by using a circular forming tool held on

the front tool-block of the cross-slide. A combination center drill *A* is next used to spot the end, and this is followed by drill *B*, counterbore *C*, and reamer *D*. Finally the finished bushing is severed by the cutting-off tool at the rear of the cross-slide. As the turret automatically indexes at the rear of its stroke, stops at *E* for the different tools automatically move around to the stopping positions. If only one turret position is to be used, the automatic indexing may be disengaged by turning a knob.

* * *

AUTOMOBILE PRODUCTION SINCE 1910

The accompanying table shows the production of passenger cars and motor trucks for each year since 1910. The total exports of passenger cars and motor trucks are also given, together with the percentage that has been exported. This table has been obtained from the Bureau of Foreign and Domestic Commerce, the figures having been printed for the first time in *Commerce Reports* of May 19, this year. The production statistics given include the output of all plants in the United States and their branch factories in Canada.

From 1896 to 1900, inclusive, the average number of passenger cars and trucks built per year in the United States was only 2615. From 1901 to 1905 the average annual production was 14,795, and from 1906 to 1910 it increased to 92,197. In the five-year period, 1911 to 1915, the annual average rose to over 500,000; and for the period 1916 to 1920, to over 1,750,000.

PRODUCTION AND EXPORTS OF AUTOMOBILES FROM 1910 TO 1923

Year	Production			Exports	
	Passenger Cars	Motor Trucks	Total	Total	Per Cent of Production
1910	181,000	6,000	187,000	8,443	4.5
1911	199,319	10,655	209,974	15,807	7.5
1912	356,000	22,000	378,000	23,863	6.3
1913	461,500	23,500	485,000	33,602	6.9
1914	543,679	25,375	569,054	34,130	6.0
1915	818,618	74,000	892,618	76,218	8.5
1916	1,493,617	90,000	1,583,617	96,858	6.1
1917	1,740,792	128,157	1,868,949	99,002	5.3
1918	926,388	227,250	1,153,638	76,781	6.7
1919	1,657,652	316,364	1,974,016	124,549	6.3
1920	1,883,158	322,039	2,205,197	267,872	12.1
1921	1,514,000	147,550	1,661,550	97,852	5.9
1922	2,406,954	252,668	2,659,622	188,810	7.1
1923	3,694,237	392,760	4,086,997	327,875	8.0

Machinery

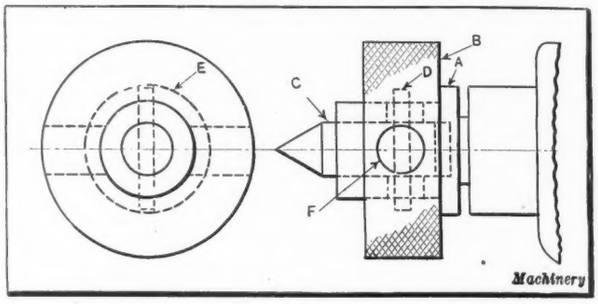
* * *

In certain instances, oxy-acetylene welding is now taking the place of silver soldering. In one case, a manufacturer of automatic refrigerators was using tanks welded by the oxy-acetylene process in the ammonia system, but the floats and the connections to the tanks and the coils were silver-soldered. Owing to the length of the joint and the large quantity of solder used, this method proved quite expensive, so it was decided to experiment with the oxy-acetylene process. The two sections of the float were flanged and a special jig was constructed which revolved the hemispherical sections of the float slowly in front of the oxy-acetylene flame, where the flanged edges of the sections were fused together. The welded samples were tested by subjecting them to an internal air pressure of 100 pounds per square inch while submerged in a tank of water, and were found to be airtight. The method was developed through the assistance and advice of the service engineer of the company supplying the oxy-acetylene apparatus, and this indicates how new methods may be developed by cooperation between manufacturers and users of equipment.

QUICK-ACTING LATHE CENTER

By HARRY MOORE

When work is loaded on an arbor and then placed between lathe centers, considerable time is often spent in adjusting the tailstock center to obtain the correct bearing pressure. The quick-acting center illustrated herewith was designed with the object of speeding up production by eliminating the time-consuming process of adjusting the tailstock center. This center consists essentially of the sleeve *A* having a taper shank which fits the tailstock spindle, a knurled ring *B*, and the center *C*. A hole is bored in the front end of sleeve *A*, which is a good sliding fit for the center *C*, and



Lathe Center that permits Arbors to be changed quickly

a slot is cut for the pin *D*, as indicated. Pin *D* is a drive fit in the center *C*. The knurled ring *B* is bored out to fit sleeve *A*. A hole *F* drilled through ring *B* permits pin *D* to be inserted in the center *C*.

When the quick-acting center is in use, the tailstock is so positioned on the lathe bed that a quarter turn of ring *B* will carry the center *C* forward into the correct position for holding the arbor. This action is obtained by having a recess *E* cut in ring *B* through the center of hole *F*. It will be evident that when the axis of pin *D* is parallel with the axis of hole *F*, the center *C* can be made to slide to the right far enough to permit the arbor to be placed between the centers. With a center of this type, which can be withdrawn or pressed forward into the operating position with a simple quarter turn of a knurled collar, there is very little time lost in changing arbors.

* * *

CONFERENCE OF COLLEGE PROFESSORS

In an effort to cooperate with educational institutions throughout the country, the General Electric Co., Schenectady, N. Y., has arranged for a conference of college professors to be held at Schenectady from July 7 to August 9. The object of the conference is to give each visiting professor an opportunity to acquaint himself with the subject in which he is particularly interested, and each man will spend the greater part of his time in the department the work of which most closely coincides with his teaching interests. Twice a week visits of inspection are made throughout the plant, followed by round-table conferences with the engineers of the plant. Evening meetings are also held. It is believed that opportunities of this kind will materially aid the educators in bringing the latest ideas in industry to their students.

* * *

REAMERS FOR AUTOMOBILE BEARINGS

A chart published by the Keystone Reamer & Tool Co., Millersburg, Pa., giving the number of automobiles, trucks, and tractors that have similar sizes of holes in their bushings, guides, or bearings, so that the same reamers can be used, indicates that thirteen different expansion reamers are required for piston-pin bushings, seven for the valve guides, seven for the connecting-rod bearings, four for the steering-arm bushings, six for the king-bolt bushings, and five for the spring-bolt bushings in all the automobiles, trucks, and tractors manufactured in the United States.

Causes of Spring Failures

By J. W. ROCKEFELLER, Jr., Manager, Spring Division, John Chatillon & Sons, New York City

WHEN a spring fails in service, it is usually replaced by one of similar design, the cause of fracture is attributed to defective material, and the matter given little further thought. Should the second spring fail after a short life, and the third and fourth behave in a like manner, the spring formulas in a handbook may be consulted to determine whether the member causing the trouble has been properly designed. Mathematical formulas in general, and those pertaining to spring design in particular, are useful tools. They are most valuable, however, when the limits of their application are known, for there are particular cases not infrequently encountered to which the general rules for spring design do not apply.

First of all, it must be realized that although practically every spring in service is operating under dynamic conditions, the basis of all spring formulas in common use is static. In none of the formulas has the moment of inertia of the spring itself been considered, nor has the factor of time been taken into account. It has been assumed that in a helical spring of constant diameter and uniform-section wire, every coil will deflect an equal amount and each will bear an equal share of the stress. While this assumption approximates actual conditions in most cases, it fails to represent the existing circumstances when the spring is deflected at a very high frequency. Under such conditions one coil may be deflected considerably more and at a correspondingly higher stress than another coil in the same spring.

It has been pointed out in the article "Common Fallacy in the Calculation of Extension Springs," published in March, 1923, MACHINERY, that in an extension spring the combined bending and tension stresses at the base of the hook are more than twice the torsional stress in the body of the spring, as indicated by the commonly employed spring charts and formulas. This is a fact frequently overlooked by spring designers. There are exceptions to the general law of spring formulas besides those mentioned, but these exceptions do not warrant our scrapping all existing tables and charts or even regarding them with suspicion. Wherever springs are used or manufactured in large quantities, some form of rapid calculation is absolutely necessary, be it slide-rule, table, or chart. These devices, however, must

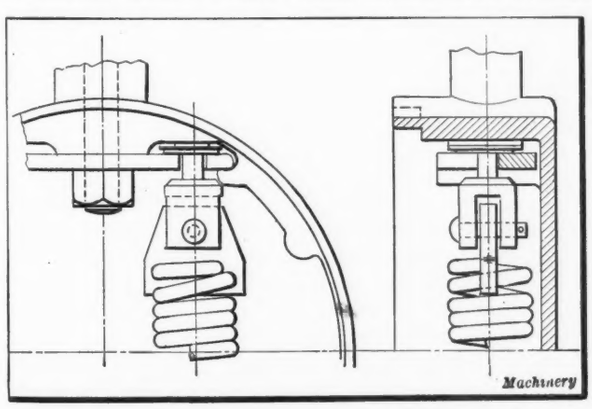


Fig. 1. Spring so designed as to avoid the Use of Hooks

be considered aids to, rather than substitutes for, engineering knowledge.

Too often "defective material" is the cause to which spring failure is attributed, simply because this explanation requires least thought on the part of the one making the report. To be sure, in every case of failure, the material is not of sufficient strength to stand up under the conditions to which it is subjected, and in this sense the fault lies in the material. On the other hand, it is often the case that no known material would survive the service that caused the failure of this so-called "defective material."

Let us review some of the causes of spring failure and their remedies, bearing in mind the fact that in the statements that follow no attempt is made to cover all conditions. Rather, let us regard the following merely as guides for similar cases. It frequently happens that in certain electrical work, as well as in high-speed internal combustion engines, abnormal stress will occur at one particular point in the spring with consequent localized failure. Often a large number of springs will fail at exactly the same position in the coil, and yet appear to be perfectly sound throughout the remainder of their length. The remedy to be applied in such a case is to redesign the spring in order to insure a more nearly uniform distribution of strain and a corresponding equalization of stress throughout the spring. This has been accomplished in some cases by a differential helix diameter. Where the frequency of compression is to vary, as in automobile valve springs, this is a problem meriting considerable study.

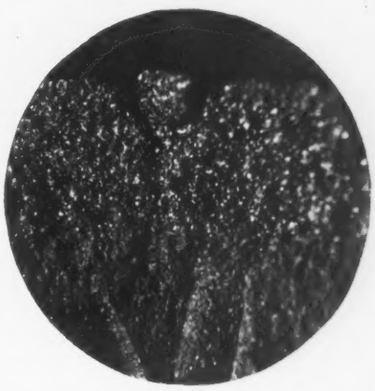


Fig. 2. Typical Fatigue Fracture greatly magnified

The eliminating of excessive stresses at the base of extension spring hooks has been accomplished in one case, at least, by eliminating the hooks themselves. Fig. 1 shows the method employed by John Chatillon & Sons to prevent hook breakage in a heavy-duty spring balance. Instead of using a hooked spring, the spring is threaded in a metal runner, as shown. In a device of this type, it is important that the holes in the runner be correctly spaced. If the distance from the hole to the edge of the runner is too great, the strain will be excessive and failure of the spring will result. If it is too small, an opening will occur between the spring and the edge of the runner before the full load has been applied, causing non-uniform calibration. The proper distance is very slightly greater than the distance between adjacent coils when the scale is loaded to capacity.

Fatigue as a Cause of Failure

A frequent, though no doubt exaggerated cause of spring failure is fatigue, and failures due to this cause are often encountered in valve springs. Exactly what happens within the material in a case of this kind is a matter open to discussion. Fig. 2 shows a typical fatigue fracture greatly magnified. It will be seen that the point at which the fracture started is worn quite smooth, while the last section to fail shows a torsion fracture very much like that exhibited by any straight torsional failure.

The most satisfactory manner in which fatigue failure can be reduced (provided, of course, that the spring has been properly heat-treated) is by redesigning the spring so as to reduce the fiber stress in the coils. In some cases the

substitution of an alloy for a straight carbon steel has increased the life of the spring. The writer is loath to accept the contention of some metallurgists that the fatigue limit of a material may be related directly to its proportional limit or ultimate strength, especially when the material happens to be a high-carbon steel. For this reason he does not recommend increasing the temperatures of thermal treatment as a cure for fatigue.

Designing a Spring to Lift a Dead Weight

Occasionally a case arises in which a spring must lift a dead weight a given distance. Obviously, the force exerted by the weight remains constant, while that exerted by the spring must vary as it deflects. In designing such a spring, the stress is reduced to a minimum by making the load deflection line slope as gently as possible. Breakage in a pump spring was overcome by resorting to this simple expedient. The accompanying table and the chart Fig. 3 illustrate the method by which this was accomplished. When the spring was compressed to a length of 2½ inches, it had to be capable of supporting 30 pounds. It is apparent that at any smaller compressed length it would lift at least that amount of weight, so the force exerted by the spring at shorter lengths was not important. The compressed maximum fiber stress in this case was reduced from 70,000 pounds per square inch to 60,000 pounds per square inch.

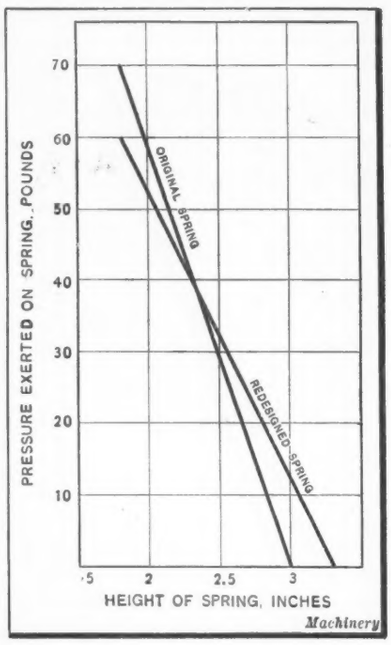


Fig. 3. Chart showing Comparison between Deflection and Strength of Original and Redesigned Springs

Often cases of over-stressing may be revealed simply by checking the design of the spring against a chart or formula. In almost every instance of failure, an improvement will be shown if the maximum fiber stress to which the spring is put is reduced. An important rule to bear in mind in this connection is that the minimum fiber stress for a given load and deflection is obtained by using the heaviest possible spring that will meet the conditions. The heaviest possible spring may be interpreted as one of the greatest solid height and outside diameter that will fit in the available space.

DATA FOR REDESIGNED SPRING

	Original Spring	Redesigned Spring
Free height, inches	3.000	3.300
Solid height, inches	1.200	1.500
Outside diameter, inches	1.125	1.200
Diameter of wire, inches	0.135	0.135
Height under 30-pound load, in.	2.500	2.550
Stroke, inches	0.700	0.700
Height at end of stroke, inches	1.800	1.800
Pressure at end of stroke, lbs.	70	56
Stress at end of stroke, lbs.	70,000	60,000

Machinery

Failure Due to Faulty Material

In some cases the cause of spring failure lies in the material. It may have been a poor quality steel or of improper analysis at the start. Again it may have been burnt or suffered other abuse in the course of thermal treatment. Failures due to these causes are clearly the fault of the manufacturer of the spring, and designate their own remedies. In comparison with other causes of failure, however, they are relatively few. Accurate methods of heat-treatment are the rule in the average spring shop of today, and the majority of failures may be traced directly either to entire disregard of fundamental principles of spring design or lack of a clear understanding among the user, the designer, and the manufacturer of the springs.

* * *

ASSEMBLY CARD SYSTEM

By JOHN J. BORKENHAGEN

An assembly card system which the writer has found to be very satisfactory for factory use and for general reference purposes is shown in the accompanying illustration. Five duplicate cards are made up and distributed to the engineering, cost, service and repair, assembly, and production departments. The original copy is filed in the cost department. These cards are of great assistance in the service and repair department in making replacements. In the production department they are referred to in scheduling the production of the various parts. The cards are made out in the engineering department at the time the blueprints are completed.

Assem. No. A-911
Name Reverse Bonnet Assembly No. used Elec. Washer
Assembly consists of:-
#3106 - Reverse Bonnet
#3104 " " Cover
#3104 " " Gears 2 used.
#3104 " Pinion
#2992 " Gear Shaft
#2993 Studs 4 used
#2994 " Nuts 4 used
2 - #9 Woodruff keys
½ pt #600 W Grease
Date 4-8-24
Dept. #44 Signed J. B.

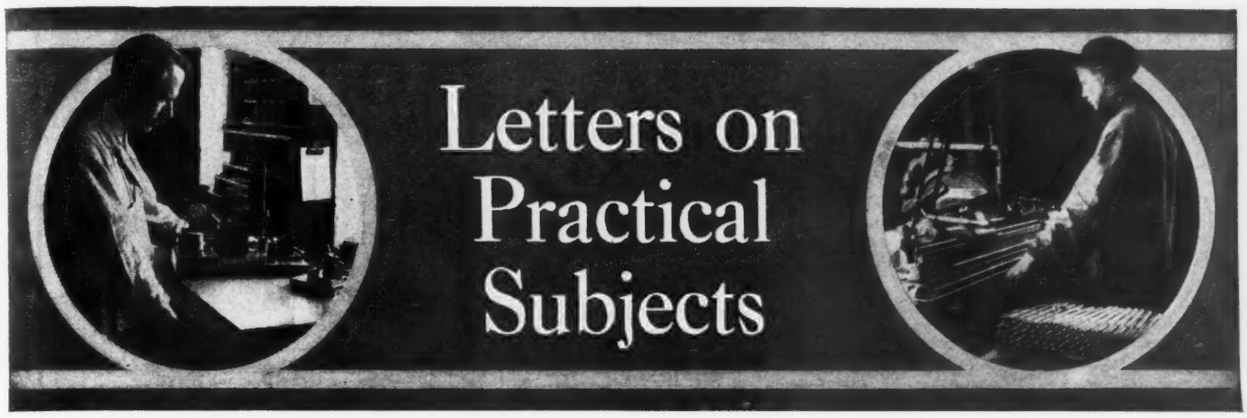
Card on which the Names of All Parts of an Assembled Unit are listed

* * *

THE FRENCH MARKET FOR MACHINE TOOLS

Assistant Trade Commissioner Wilson K. Ray writes from Paris to the Bureau of Foreign and Domestic Commerce that the French market for machine tools improved greatly during the early part of the present year. In the first months of 1924, dealers representing American concerns received a number of orders that could not be filled from warehouse stocks in France and that are not produced by French machine tool builders. British machine tool firms also shared in the business created by this demand. German manufacturers, however, were unable to compete, both because their prices at present are higher and because they were unable to guarantee delivery dates. Of late, however, the volume of orders for metal-working machinery has fallen off, due to the rise of the franc, and it is likely that machine tool users will hesitate to proceed with the installation of new equipment until the franc is stabilized.

It is the somewhat special types of American machine tools that have found a ready market in France, whereas the more standardized machines have to meet the active competition of French machine tool builders. In spite of this several orders for lathes, for example, are reported as having been placed with American makers since the first of the year, and it is quite certain that some of the well-known makes of machine tools, even of the standard type, will continue to be imported from the United States in spite of the higher prices they command.



INTERNAL DRILLING AND MILLING ATTACHMENT

The internal drilling and milling attachment shown mounted on a hand miller in Fig. 1 is used primarily for opening the ports in hammer drill cylinders. It was designed and built in the plant of the Canadian Ingersoll-Rand Co., at Sherbrooke, Quebec. The attachment is shown in position for opening the ports in the cylinder *A*, which is mounted on the fixture *B*.

The body *C* of the attachment is graduated as shown in Fig. 2. These graduations permit the drill *D* to be readily located at any desired position or depth within the cylinder. The main body of the fixture consists of a casting which is clamped to the over-arm of the miller. The projecting arm that carries the drill *D* is cored out and contains a train of gears, as indicated in Fig. 2. A taper shank *E*, held in the milling machine spindle, drives the drill through the train of gears.

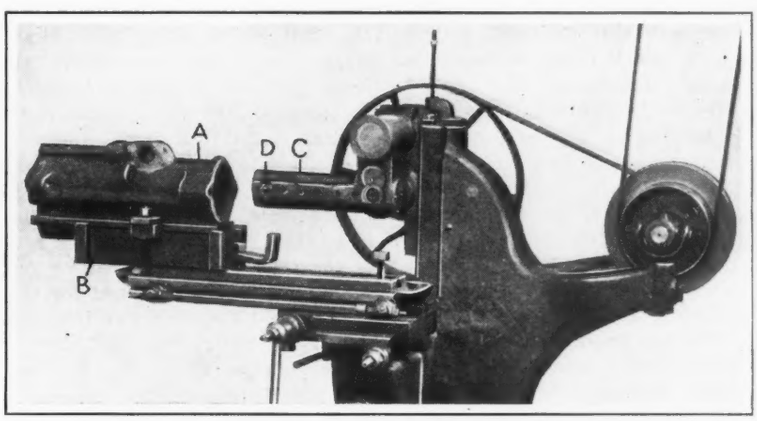


Fig. 1. Drilling and Milling Attachment used for opening Ports in Hammer Drill Cylinders

The bushing or socket *F*, shown in section *X–X*, runs in a bronze bushing and is threaded and tightly screwed into the driven gear *G*. The method of assembling the driving shaft *H* and gear *J* is similar to that used for bushing *F* and gear *G*. Thin plates secured to the ends of the arm *C* serve to close the cored hole and thus retain the lubricant and prevent chips or dust from interfering with the gearing.

Sherbrooke, Quebec, Canada — H. V. HAIGHT

RATCHET FEED MECHANISM

Mechanisms for obtaining both intermittent and continuous feeds that will permit of minute adjustments are sometimes required. A mechanism of this kind which has been successfully applied to two machines within the last few years, is shown in the accompanying illustration. This mechanism was first applied to a horizontal drilling machine used to drill a hole 1 3/32 inches in diameter and 18 inches long in a chrome-nickel steel crankshaft. It was found, upon trial, that a feed of exactly 0.007 inch per revolution was not only the ideal feed for this work but was practically the only one that could be used with satisfactory results. For some unexplained reason, a feed of 0.008 inch made the drill chatter,

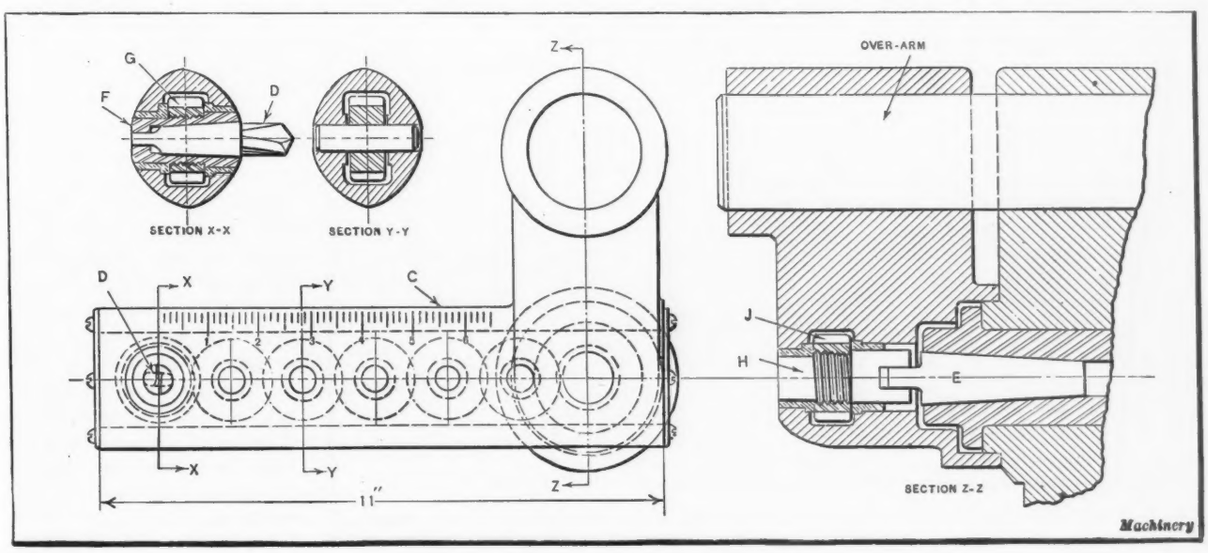
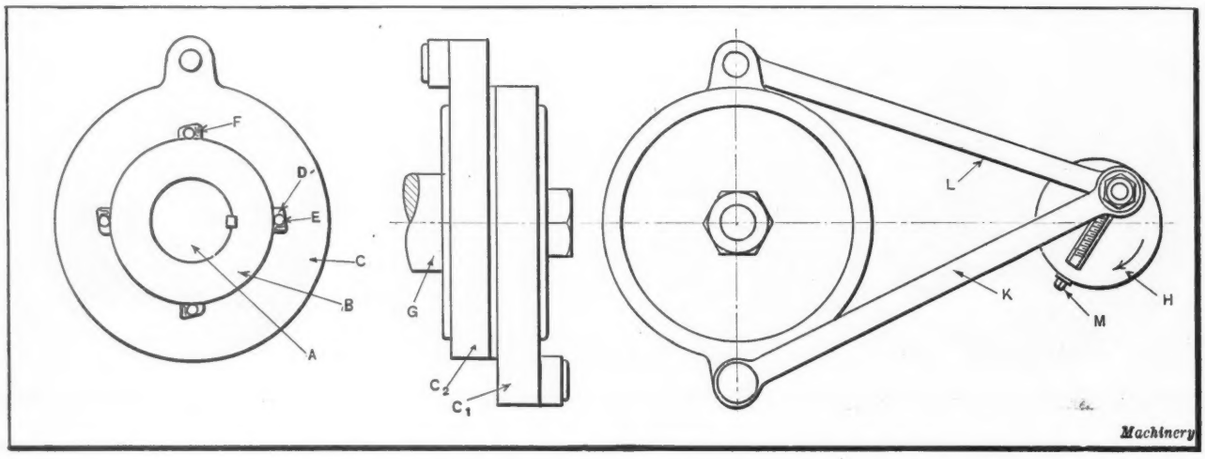


Fig. 2. Milling Machine Attachment for Internal Drilling



Adjustable Ratchet Feeding Mechanism used on a Drilling Machine

while a feed of only 0.006 inch caused the work to become glazed so that the drill would not cut after being in use a short time. The drill used for this job was of the oil-tube twist type, with flutes 20 inches long, and was made of high-speed steel.

A feed of the same type as was used for the crankshaft drilling operation was successfully applied to a machine for cutting fabrics. It may be mentioned here that a feeding mechanism of the type described can also be used to advantage in connection with the roll feeds of punch presses. The mechanism used for the drilling operation is of the continuous-feed type, but when used with the fabric cutting machine or in connection with punch press feeding rolls, it is employed to give an intermittent feed.

Referring to the accompanying illustration, the feed or drive shaft *A* is keyed to a hardened and ground steel collar *B* around which is placed a hardened and ground ring *C*. In ring *C* are suitable recesses *D* in which are placed hardened rolls *E* that are backed up by springs *F*. The action of this unit is as follows: When the outer ring *C* is rotated counter-clockwise, there is practically no resistance to its movement, but if it is rotated clockwise, the hardened rolls *E* are forced against collar *B* as they ride up the inclined surface of recess *D*. The rolls finally become wedged, and thus drive collar *B* which is keyed to shaft *A*.

In order to obtain an intermittent feed, it is merely necessary to use one of the friction units which is only capable of driving shaft *A* in one direction. This unit may be connected to a rotating shaft on the machine by means of an adjustable crank, so arranged that its throw can be easily adjusted to obtain a fine or a coarse feed. For a constant feed, it is necessary to employ two units, as indicated in the two views at the right-hand side of the illustration. In this mechanism two outer rings C_1 and C_2, and one collar *B* are required. In assembling the outer rings on collar *B*, it is necessary that one be arranged to drive when it is rotated clockwise and the other when it is rotated in a counter-clockwise direction.

In the view at the extreme right-hand side of the illustration is shown the crank disk *H* and the two connecting-rods *K* and *L*. The disk *H* may be placed on the main drive shaft or any other shaft that may be conveniently located for the purpose. The screw at *M* provides a means of regulating the throw of the crank and may be equipped with a dial reading to hundredths or thousandths of an inch to facilitate the accurate adjustment of the rate of feed. When the crank-pin is adjusted so that it is exactly on the center of disk *H*, there will be no feeding movement.

When the mechanism is in operation, the crank disk *H*, rotating in a clockwise direction, moves both the connecting rods *K* and *L* in the same general direction. Assuming that the clutch ring C_1 has been assembled to drive collar *B* when rotating in a clockwise direction, it is apparent that as long as the connecting-rod *K* travels away from shaft *A*, the shaft will be driven in a clockwise direction. However, when crank *H* has been revolved through an arc of 180 degrees both connecting-rods *K* and *L* will begin to travel in the opposite direction, and it is then that clutch ring C_1 releases and clutch ring C_2 engages collar *B*.

As there is no perceptible interval between the release of one ring and the engagement of the other, a practically continuous feed is obtained. If desired, it is permissible to make the recess for the friction rolls in collar *B* instead of in the rings. This construction has the advantage of giving a slightly better contact for the friction rolls owing to the fact that the contact surface of the outer ring is formed to a larger radius.

Brooklyn, N. Y. DONALD A. BAKER

DIE FOR PIERCING SHELLS

The die illustrated in Fig. 2 was designed for piercing the four holes *a*, *b*, *c*, and *d* in the shell shown in Fig. 1. The shape or construction of some of the parts of this die are shown more clearly in Fig. 3. In the latter illustration the parts are identified by the same reference letters as are used in Fig. 2. The shell to be pierced is placed on the die-block *E* which is provided with four piercing dies, *a*, *b*, *c*, and *d*, Fig. 3. The piercing punches *A* and *B* are held in bushings *L* inserted in the block *F*. The punches *C* and *D* are held in the slide blocks *G* and *H*, respectively. The slide blocks are constructed exactly alike, as are also the punches *C* and *D*. These punches are held in place by pins *J* which are backed up by screws *K*.

On the down stroke of the press ram, the beveled por-

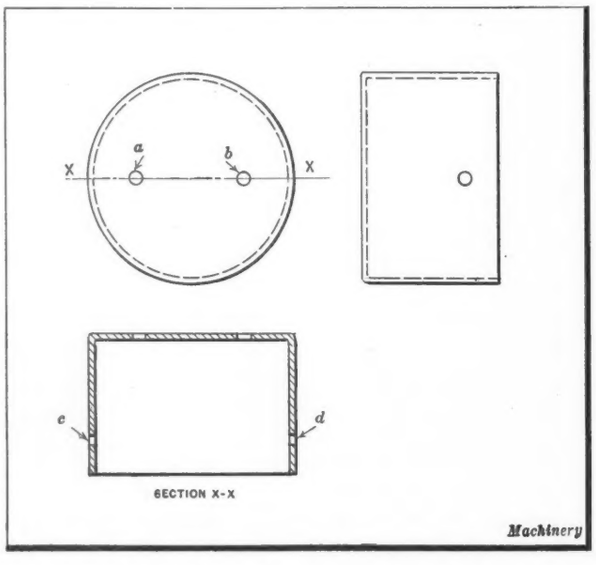


Fig. 1. Shell in which Four Holes are pierced by Die shown in Fig. 2

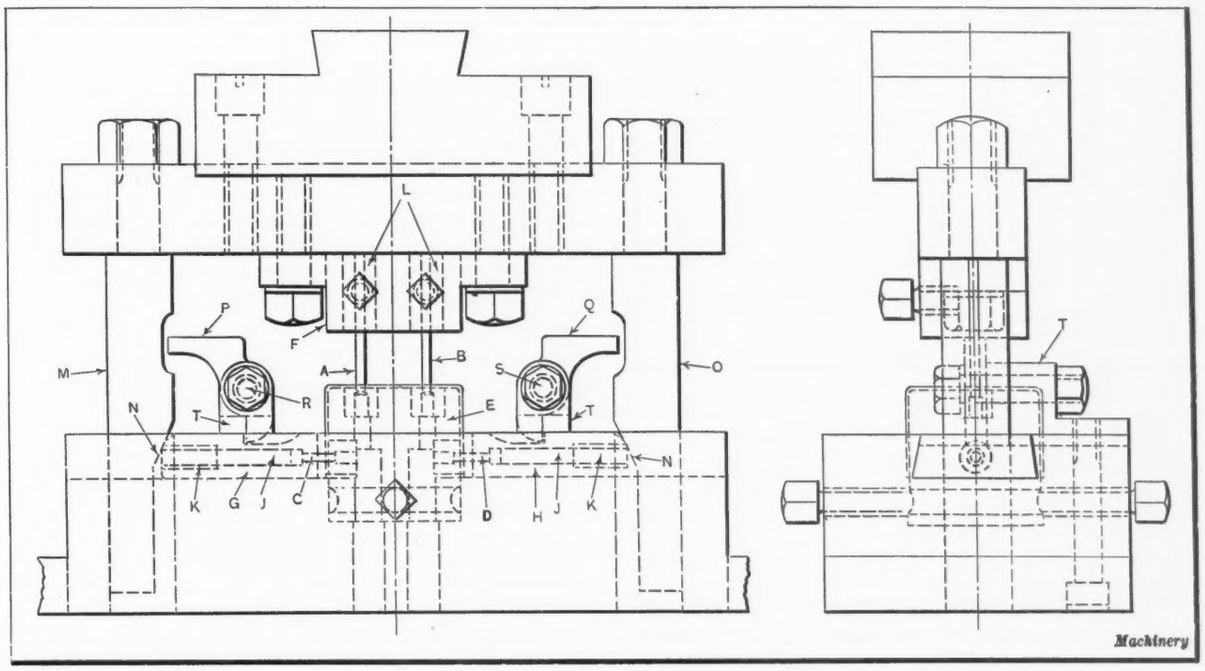


Fig. 2. Die designed for piercing Four Holes in Shell shown in Fig. 1

tions *N* of the studs *M* and *O* force the slide blocks *G* and *H* inward so that punches *C* and *D* enter the dies inserted in the sides of die-block *E* and thus pierce the two holes *c* and *d*, Fig. 1. The holes *a* and *b* are also pierced on the down stroke by the punches *A* and *B*, Fig. 2. On the up stroke the outer ends of the punch releasing dogs *P* and *Q* are forced upward by the lower ends of the notches on the inner sides of studs *M* and *O* coming in contact with them. This action causes the dogs to pivot on studs *R* and *S* so that their lower ends will come in contact with the notches in the slide blocks *G* and *H* and force the latter outward, thus withdrawing the punches *C* and *D* from the holes in the shell. It will be noted that the releasing dogs are mounted on blocks *T* which are secured to the die-shoe by fillister-head machine screws.

Dies of the same general design as the one illustrated can be made for piercing a greater or smaller number of holes in the ends and sides of shells. For instance, four slides like the one shown at *H*, Fig. 3, could be used so that four holes would be punched simultaneously in the sides of the shell. Three holes could also be punched by using three of these slides. Again it is possible to use thicker slides, so that two punches can be mounted one above the other. It may be well to mention here that in setting up a die like the one described, care should be taken to have the stroke short enough to prevent the studs *M* and *O* from being withdrawn from the holes in the die-shoe.

Torrington, Conn. S. C. HILLS

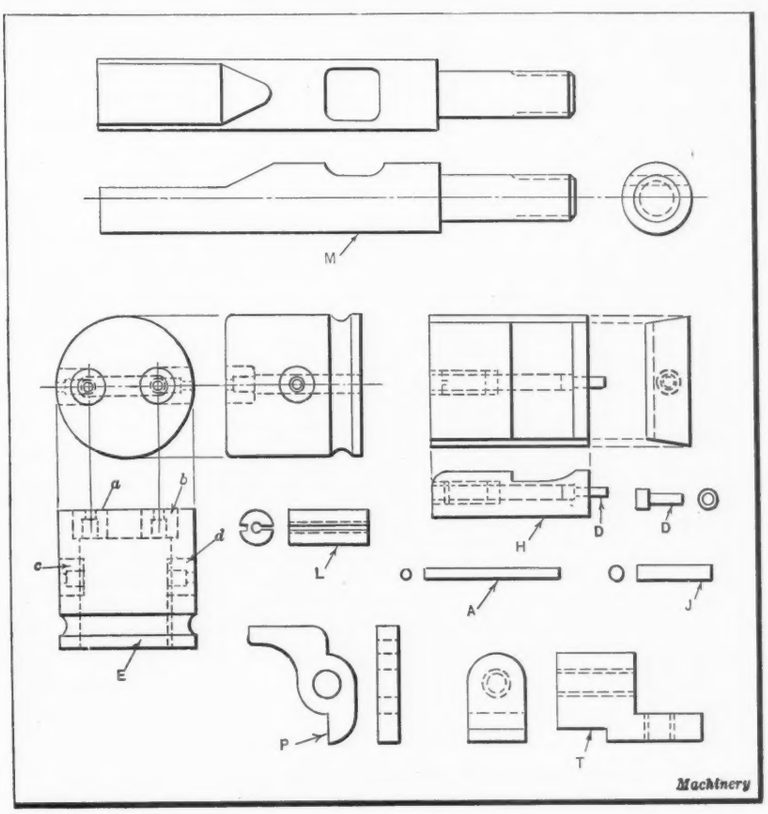
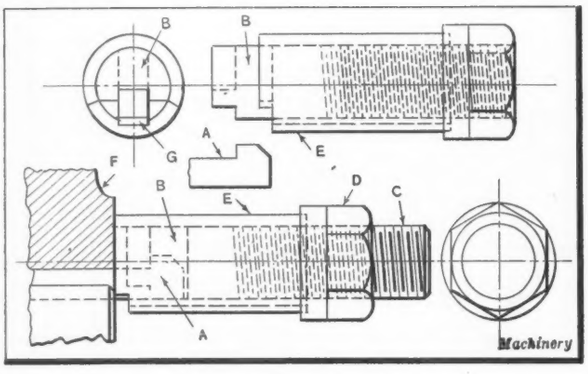


Fig. 3. Various Parts used in the Die shown in Fig. 2

PULLER FOR FITTING TAPER KEYS

The results obtained in handling any kind of machine shop work depend largely upon two factors, namely, the tools employed and the procedure followed in using the tools. In fitting taper keys, the method usually followed is to drive the key part way in, then remove it, and work down the high spots. This procedure is repeated until the key has an even bearing in the keyway and can be driven into place with just the right amount of force.

It is rather a troublesome job to sledge out the key after each trial fitting, and frequently it is bent while being removed in this manner. Thus it often happens that a key is driven into its seat without being properly fitted. The necessary strength or proper functioning of a unit often depends on the accuracy with which the key is fitted. This is especially true in the case of heavy-duty machinery. With a key remover or puller like the one shown in the illustration, it is an easy matter to remove a taper key,



Device for removing Taper Keys

and a workman provided with such a device is encouraged to fit the key properly in its seat.

The lower view in the illustration shows the key puller in position for removing the key *A*. The gib or lip on the key fits into the slot *B* cut in the end of screw *C*. The front end of sleeve *E* bears against the face of the hub of gear *F* —the piece in which the key is located. The key *A* is withdrawn by turning nut *D*, which causes screw *C* to be drawn outward. The key slides on the plate *G* so that the danger of its being bent is very slight. As screw *C* is subjected to severe strains, it is made of nickel steel. A key puller of the design illustrated having a screw *C* 1½ inches in diameter with six threads per inch has been in constant use for six months with excellent results.

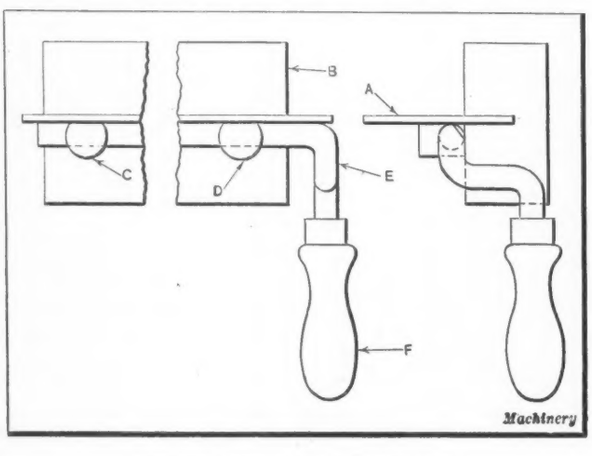
Evansville, Ind. L. BENTZEN

CLAMPING FIXTURE FOR A SHEET-METAL PART

The clamping fixture shown in the accompanying illustration is used to hold sheet-metal pieces like that shown at *A* while removing burrs from the edges with a file. Before this fixture was designed, it was the practice to hold the work in an ordinary machinist's vise. However, the time spent in clamping the work was so great that it was decided to construct a quick-acting clamp. The results obtained with the new clamping device have more than justified the expenditure involved in its construction, and the writer believes that a similar device can be used to advantage for holding a great variety of work for which the machinist's vise is generally employed.

The steel block *B* is slotted to receive the work, and two holes are drilled on one side of the slot in each end of the block into which are driven the two posts *C* and *D*. These posts are flattened on one side to permit the work to be inserted in the slot in block *B*. Holes are also drilled in posts *C* and *D* to receive the clamping rod *E* which is flattened on one side for its full length. The right-hand end of rod *E* is bent to form a lever, as shown in the illustration, and is provided with a handle *F* such as is used for files. When the lever is in its normal position, the flat surface is parallel with the flat surface cut on the sides of the posts *C* and *D*, so that the work can easily be placed in the slot in block *B*. It is evident that by moving the lever up or down, the unflattened portion will press against the work and thus clamp it firmly in place.

Rosemount, Montreal, Canada HARRY MOORE

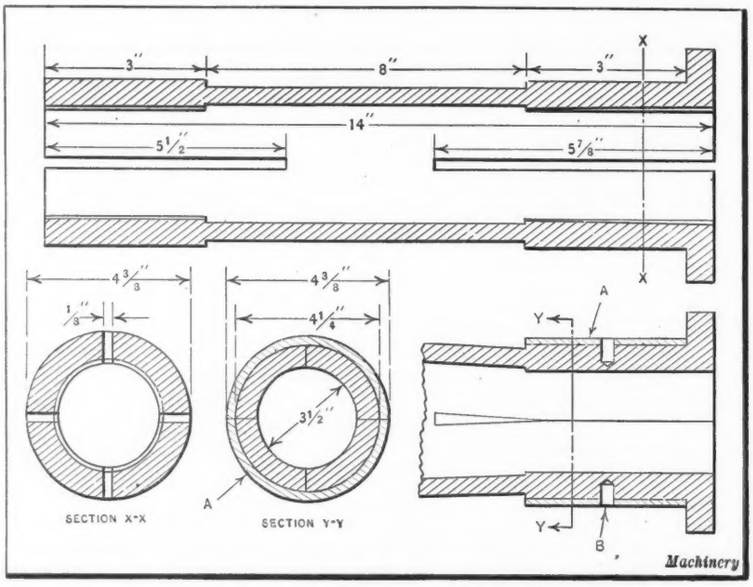


Clamping Fixture for Sheet-metal Part

REPAIRING SCREW MACHINE SPINDLES

A method of repairing worn bushings for spindles of automatic screw machines which the writer has used with success, is here illustrated. The sectional view in the upper half of the illustration shows the type of bushings repaired by the method described. The bearings at the ends of this bushing were worn down about 3/32 inch.

First, four slots were cut in the ends of the bushing with a ⅛-inch saw. Next, two bushings like the one shown at *A* were made up from pieces of iron pipe and pressed on the machine bushing. The bushings *A* were then secured in place by short pins like those shown at *B*. The job was finally completed by placing the work in a lathe and turning the bushings *A* to the required size, using fine emery cloth to produce a good finish, after which the machine bushings were rebored to fit the spindle.



Method of repairing Worn Spindle Bushings

New Britain, Conn. JOHN LARSON

CUTTING A TEN-FOOT LEAD-SCREW ON A SIX-FOOT LATHE

One of the most interesting jobs that the writer has ever seen performed in a lathe was that of cutting a 10-foot lead-screw in an engine lathe having a maximum distance between centers of only 6 feet. First the tailstock was removed from the lathe bed, and the bar stock from which the lead-screw was to be made put in position for turning and threading. One end of the bar stock was placed in a cup-shaped chuck secured to the lathe spindle. This chuck had eight clamping screws located 90 degrees apart in sets of two each. By adjusting these clamping screws, it was an easy matter to center the shaft in the chuck.

A steadyrest was used to support the other end of the work while turning a short bearing surface for the steady-

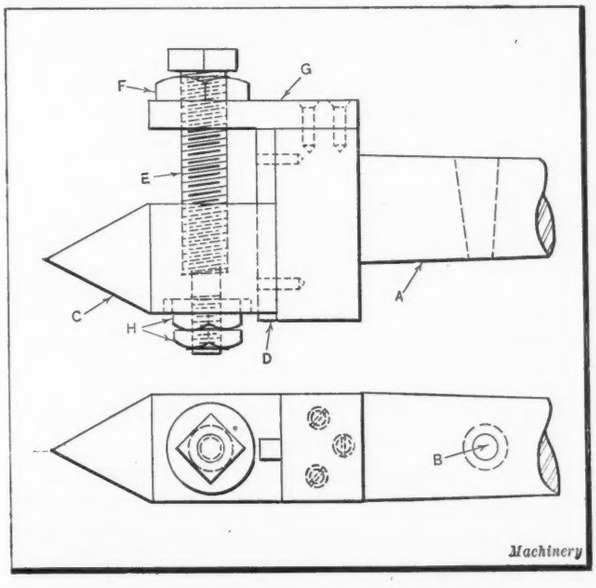
rest jaws, which were then adjusted to support the work on the finished bearing surface. The portion of the work between the chuck and the steadyrest was turned down and threaded. The work was next reversed so that the steadyrest supported the threaded end. The other end was then turned down to size and threaded so that the thread extended the full length of the lead-screw.

Chemnitz, Germany TH. R. WAGNER

OFFSET LATHE CENTER FOR TAPER WORK

The offset lathe center here illustrated was designed for use on a lathe that was not equipped with a taper turning attachment. The job on which it was employed was such that the tailstock could not be set over for turning the taper, it being necessary to keep the tailstock lined up accurately with the spindle for the straight turning operations. Also it was impossible to use the compound rest, as the slide did not have the required length of travel.

Referring to the illustration, *A* is the tapered shank, which is held in the tailstock by a taper pin passing through hole *B*. The center *C* has a slot cut in its base, which is a



Adjustable Offset Lathe Center for Taper Turning

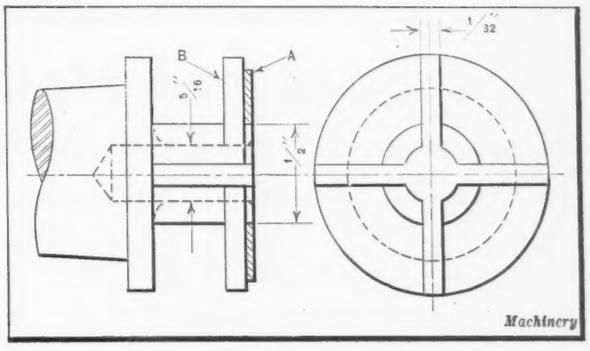
good sliding fit on the key *D* that is pinned to the face of shank *A*. The threaded stud *E* is used in adjusting the center *C* to the required offset position, after which the lock-nut *F* is tightened to secure it in place. Stud *E* is threaded to fit the tapped hole in plate *G*, which is secured to shank *A* by three flat-head machine screws. The shoulder on the turned-down end of stud *E* rests on the bottom of the counterbored hole in center *C*. The lock-nuts *H* serve to hold the center on stud *E*. For light work, this construction has proved satisfactory.

Denver, Colo. R. M. THOMAS

ARBOR FOR FACING THIN WASHERS

Recently the writer was given the job of finish-facing seventy washers like the one shown in the cross-sectional view at *A* in the accompanying illustration. Ordinarily this kind of work was handled on a universal grinder, but as this machine was engaged on other work, the writer decided to perform the facing operations on a lathe. As the washers were only 7/64 inch thick, the problem of holding them on a lathe arbor in such a way that they could be easily faced was not an easy one to solve. After a little thought, however, the writer devised the holder shown in the illustration.

It will be noted that the work is slipped over the boss on the end of the arbor and that it is backed up by a collar *B*.



Expansion Arbor for Thin Washers

This collar, as well as the small section back of it, is split or slotted, as indicated in the end view. After placing the arbor in the lathe spindle and locating the piece of work on the projecting end as shown, the tailstock center is brought forward and tightened so that it expands the end of the holder, thus securing the work in place. It might be mentioned here that the arbor was made from cold-rolled steel and casehardened. Only about a half an hour was required for finish-facing the seventy washers.

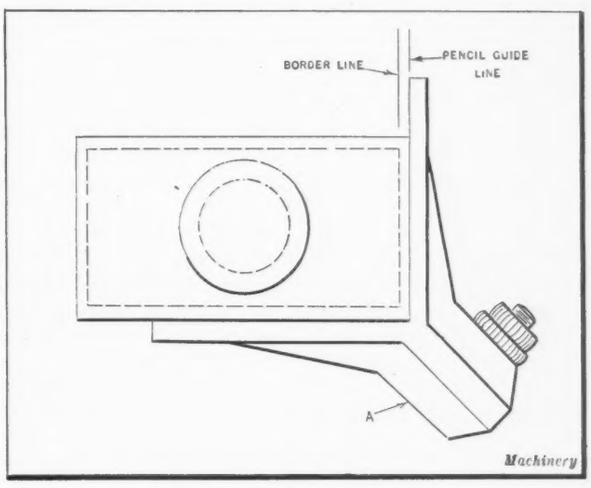
Baltimore, Md. WILLIAM A. BAUS

POSITIONING A RUBBER TITLE STAMP ON A DRAWING

It is desirable that titles stamped on drawings with rubber stamps be uniformly and evenly positioned on each drawing. Usually the lower border line made by the stamp and the vertical line which joins it at the right-hand side of the title are required to coincide with similar border lines at the lower right-hand corner of the drawing. It is a simple matter to line up the rubber stamp so that this condition will be obtained by using a machinist's center square *A*, as shown in the illustration.

Vertical and horizontal lines should be drawn with a pencil before placing the center square in position. The distance of these pencil lines from the border lines of the drawing should be the same as the distance between the border line on the title and the edge of the block on which the stamp is mounted. After the guide lines have been drawn, the center square is placed on the drawing with its edges on the pencil lines. The square is held in place with the right hand while the stamp is pressed down on the drawing with the left hand, being guided by the square. When contact is made with the drawing more pressure is applied with both hands after the center square has been withdrawn. If a center square is not available, a device of similar shape made up from wood can be employed.

Chicago, Ill. WILLIAM H. KELLOGG



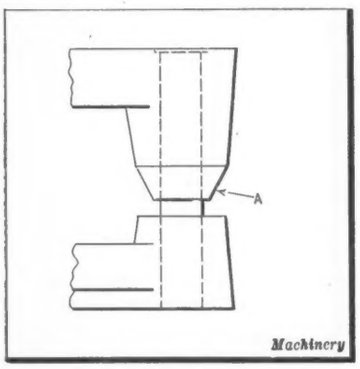
Method of locating Title on Drawing

Shop and Drafting-room Kinks

SAFETY KINK FOR PILLAR DIES

Pillar dies for use in power presses are sometimes so designed that the upper and lower members come close together at the post bearings at each stroke of the press. In such cases there is danger of the operator being seriously injured unless adequate guards are provided. Sheet metal or tubing guards will prevent the operator's fingers or hands from being pinched between the pillar bosses, but such guards, though satisfactory when in place, are likely to be discarded. A better way, which helps to protect the toolmaker as well as the set-up man and operator, is to taper the ends of the post bearings, as shown at *A* in the illustration. This makes the tool less clumsy than when metal guards are used.

If there are many bearings to be tapered, the job can be handled to advantage on a large drill press by providing a special hollow mill, with a pilot to fit the bearing holes. When only a limited number of bearings are to be tapered, it may be advisable to clamp the part on the faceplate in a lathe. As accurate centering is not necessary, the bearing may be held centrally on the faceplate while clamping, by running the tailstock center into the hole. If the post bearings are bushed, the end of the bushing should be tapered when the shell is thick enough to require it. In designing new dies, the taper may be provided on the pattern before the castings are made, thereby reducing the amount of metal to be removed. It would probably be difficult to cast the bosses with sufficient accuracy to make it unnecessary to machine the taper.



Tapered Pillar Die Boss

West Hartford, Conn. ERNEST L. HOLCOMB

TRY LARD FOR CLEANING THE HANDS

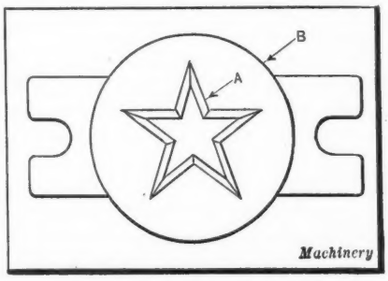
The next time you work on cast iron or on an old bearing all covered with soft black muck, try ordinary lard as a cleanser for the hands. While hand soaps prepared for the purpose do good work, they are not always available, and in some cases thin-skinned people find that they remove the skin together with the grime. Lard oil does not work well and leaves its odor on the hands, while the lard is free from this objection and can be easily washed off with soap. If an abrasive is desired, add a little cornmeal to the lard. It will help dig into the dirt, and is at the same time an emollient.

As a container for the lard, the writer uses an ordinary compression grease cup, with the feed spring removed. When empty, this container can be taken home and replenished. This kink is especially dedicated to apprentice boys who have a rival for the affections of their fair one in the shape of a ribbon clerk or a dude draftsman. A match cut to a chisel point and dipped in lard, if used as a supplementary operation on the finger nails, will remove the last traces of black. One young gentleman with whom the writer is acquainted adds violet extract to his lard on Thursday nights. However, this is optional.

Willimantic, Conn. HERBERT A. FREEMAN

DIE FORMED BY WELDING

The die shown in the accompanying illustration is made up of ten pieces of ¾- by 1½-inch tool steel welded together with an oxy-acetylene welding torch. The steel pieces, one of which is shown at *A*, were planed on the edge and one side, after which the ends were shaped to the required angles. The machined pieces were then located in their proper positions by means of a templet while their ends were joined by welding. After the welding was completed, the die was trimmed off and holes drilled and tapped for the dowels and cap-screws used in attaching the assembled steel members to the die-bed *B*. A star-shaped opening was cast in the die-bed with sufficient clearance to permit the blanked pieces to pass through.



Die formed by welding Steel Pieces together

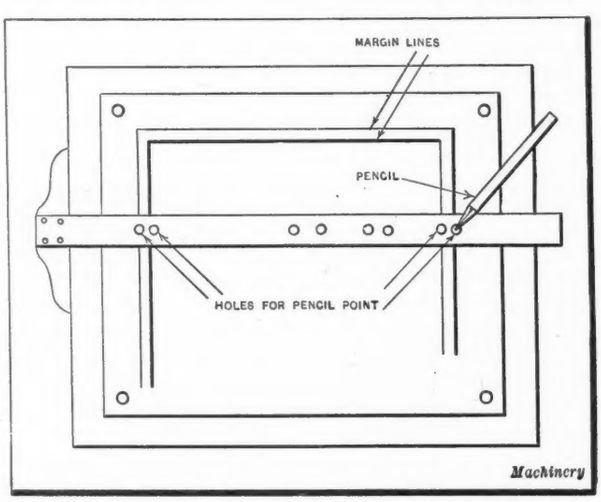
The cutting part of the die was hardened in a bath of oil, salt, and water, and was not drawn or tempered. The punch was made in the same manner as the die except that the holder was made round instead of star-shaped. Dies for making three sizes of stars from sheet stock were made in the manner described, the largest being about 14 inches across points and the smallest about 9 inches.

Brooklyn, N. Y. LEWIS ROE

QUICK METHOD OF DRAWING BORDER LINES

Time may be saved in laying out the margin or border lines on a drawing by using a T-square with small holes drilled through the blade, as shown in the accompanying illustration. These holes serve to guide the pencil, and should be made just large enough to permit the point of the pencil to pass through the blade. The spacing of the holes should correspond with the dimensions of the various sizes of sheets used in the drawing-room. The horizontal lines are drawn in the same manner as the vertical lines by placing the head of the T-square against the lower edge of the drawing board.

Poughkeepsie, N. Y. JOHN J. THOMPSON



Using a T-Square to guide Penoil when drawing Border Lines

Questions and Answers

CITATION AGAINST A PATENT APPLICATION

R. A. B.—I have an application for a patent pending in the United States Patent Office, against which has been cited, as a reference, a foreign patent issued about six months ago, and also a United States Patent issued nearly a year ago. Both of these patents approach my invention closely, but do not lay claim to certain features that I am anxious to protect. What is the proper procedure in a case of this kind?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

The law specifically provides that where an application for a patent is rejected on reference to an expired or unexpired domestic patent that substantially shows or describes, but does not claim, the rejected invention, or on reference to a foreign patent, and the applicant makes oath to facts that show a completion of the invention in this country before the filing of the application on which the domestic patent was issued, or before the date of the foreign patent, and shall also make oath that he does not know and does not believe that the invention has been in public use or on sale in this country, or patented or described in a printed publication in this or any foreign country for more than two years before his application, and that he had never abandoned the invention, then the patent or publication will not act as a bar to the grant of a patent to the applicant, unless the date of the patent or publication is more than two years prior to the date of filing in this country. The failure of a previous inventor to lay claim to all that might have been granted to him is considered an abandonment or disclaimer of his rights.

COMPRESSED FIBER

H. H.—I should be glad to have information on the following points in connection with compressed fiber as used for engineering purposes:

1. Is the fiber treated with any adhesive, or is compression the sole agent of adhesion?
2. What pressure per square inch is used in compression?

A.—Compressed and vulcanized fibers for engineering purposes are products of the special cellulose industries. Vulcanized fiber is produced by treating the perfected cellulose with zinc chloride solvents and cementing together a number of sheets when in the colloidal hydrated state. The product is thoroughly washed to remove every trace of soluble electrolytes, which is particularly necessary when the material is used for electrical insulation. The presses employed may be arranged to provide a plain or embossed surface, and the pressure varies considerably, according to the particular product, which for engineering purposes is generally graded as "hard" or "flexible." Thin sheet fiber may be manufactured and treated in roll form by continuous machinery.

The vulcanizing ovens are usually long insulated chambers, heated by steam coils. The temperature is automatically controlled and recorded, and the instrument provided for this purpose is designed to control the steam supply so that the temperature is gradually increased for a predetermined period until the vulcanizing temperature is reached. The heat required is approximately 225 degrees F., and it is held at this temperature for an hour, or until vulcanizing is complete where a longer period is necessary.

Vulcanized fiber is insoluble in all ordinary solvents, and is not affected by alcohol, ammonia, benzine, or any of the animal, vegetable, or mineral oils, although it absorbs water freely and swells when wet, but is not otherwise injured. Fiber does not melt or soften when heated, but at a high temperature it chars and loses its elasticity; cannot be molded, but is readily machined and will take a fine polish; possesses strength and density of a metal, yet is elastic and nearly as light as hard wood. The tensile strength varies from 10,000 to 20,000 pounds per square inch. The elastic limit is about 4000 pounds, but is not clearly defined, and there is no permanent set even at the rupture point.

WHAT IS MEANT BY "NUMBERS HARD"?

H. S. T.—From mill salesmen I have often heard the expression "numbers hard" in reference to wire and sheet stock. Just what does it mean?

ANSWERED BY ALAN MORRIS, SALES ENGINEER, BRIDGEPORT BRASS CO., BRIDGEPORT, CONN.

The statements in the following explanation apply most strictly to brass, though in basic metallurgical principle, they apply to other metals as well. In general, the greater the amount of cold working to which a metal is subjected, the stronger, harder, stiffer, and more brittle it becomes. If a piece of soft annealed metal 0.1 inch thick is cold-rolled to 0.05 inch, it will have a certain hardness, and if another piece of the same soft annealed metal 0.2 inch thick is cold-rolled to 0.1 inch, it will have the same hardness as the first piece. This is because, in each case, the metal has been rolled to half the original thickness. Hence, it has been given a 50 per cent reduction in cross-sectional area.

PERCENTAGE OF REDUCTION IN AREA FOR "NUMBERS HARD" (WIRE AND SHEETS)

"Numbers Hard"	Round Sections, Per Cent	Sheets, Per Cent	"Numbers Hard"	Round Sections, Per Cent	Sheets, Per Cent	"Numbers Hard"	Round Sections, Per Cent	Sheets, Per Cent
1	20.8	11.0	6	75.1	50.0	11	92.2	72.1
2	37.2	20.7	7	80.3	55.5	12	93.8	75.1
3	50.0	29.4	8	84.3	60.5	13	95.1	77.8
4	60.5	37.2	9	87.6	64.8	14	96.1	80.4
5	68.6	44.0	10	90.2	68.6	15	96.9	82.3

Machinery

Reference to a B & S gage table will show that the first piece has been reduced by cold working from No. 10 to No. 16 gage, or a difference of six numbers. Also, that the second piece has been reduced by cold working from No. 4 to No. 10 gage which is again a difference of six numbers. Thus, each piece is said to be "six numbers hard." In like manner, a metal may be 1, 2, 3, etc., "numbers hard."

There is a definite relation between "numbers hard" and percentage of reduction in area with round sections, and an equally definite but different relation with sheets. For round sections, the percentage of reduction is found as follows:

$$\frac{(\text{old area} - \text{new area}) \times 100}{\text{old area}} = \text{percentage of area reduction}$$

However, with sheet metal, the cross-sectional area is reduced in direct proportion to the thickness, so the following formula applies:

$$\frac{(\text{old thickness} - \text{new thickness}) \times 100}{\text{old thickness}} = \text{percentage of area reduction.}$$

Consequently wire "five numbers hard" has not been reduced in area the same percentage after annealing as a sheet "five numbers hard." The percentages of reduction in area corresponding to "numbers hard" from 1 to 15 for wire and sheet metal are given in the accompanying table.

STAMPING LEAD WASHERS

T. S.—I have had great difficulty in making lead washers owing to the nature of the metal. At first I used a double punch with a spring ejector, but found this was unsatisfactory, and finally had to do the job in two operations, namely, blanking and then punching the center hole. The job was for 200,000 sheet-lead washers 1/16 inch thick, 7/8 inch in diameter, with a 1/4-inch hole. I should be glad to know of a tool suitable for this work.

A.—A standard press, fitted with a double roll feed would be the most suitable for this class of work, and can be readily changed over for varying sizes. The dies should be of the progressive type, piercing at the first stroke of the press and blanking out the first piece at the second stroke, while the second piece is being pierced. If it is essential that the washers be exactly concentric, the blanking punch should be fitted with a pilot to enter the pierced hole. When this is done, the top feed rolls are lifted slightly as the pilot enters the stock, so that the pilot can move the stock either backward or forward into the correct position for making a concentric piece. With this type of tool, both piercings and blanks are pushed through the die, and the material is not spread so much as when spring ejectors are used.

Several pairs of punches, with their corresponding dies, may be fitted, according to the quantity of washers of one size required at each run, and the press should run at from 70 to 150 strokes per minute, according to the number of blanks and the feed required by the rolls. Thus, with five pairs of punches, and the press running at 100 strokes per minute, the output would be 500 per minute.

STANDARD CONDUIT THREADS

A. W.—We are manufacturing some apparatus for Canada, embodied in the instructions for which American pipe and conduit threads are specified. Can you give us any information with respect to U. S. standard conduit threads?

A.—While no national standard of present practice in threading rigid conduit has yet been made, for at least six years back there has been on paper a standard practice which we understand is generally followed by the manufacturers of this material. In November, 1917, the Underwriters' Laboratories published a bulletin covering rigid conduit. The following information concerning the thread is from this report. As will be seen, the type of thread is fundamentally based on the American standard pipe thread. As defined in the Underwriters' Laboratories pamphlet, no provision is made for gaging this conduit thread.

Threads on conduits, couplings, elbows, and bends must be full and clean-cut. When threads are cut before the pickling operation of the cleaning process, they are likely to be eaten away by the acid, so that very little metal remains, especially at the top of the threads. This condition in finished conduit must be guarded against, and calls for careful inspection and sorting by the manufacturer of the tube both before and after pickling, and before the coating is applied. When such a defect is found it must be corrected by recutting the threads, or the tube must be rejected for conduit purposes.

Sometimes threads are cut after the protective coating is applied or after the first dip, in the case of enamelled conduit. In such instances they must be treated to prevent corrosion taking place before the conduit is actually installed. When threads are cut on otherwise finished conduit, they must be given a special protective coating. If threads are cut before the final coating which protects the exterior surface of the steel tube from corrosion is applied, and are therefore treated when the tube is given its final coat, the protective coating so provided on the threads may be regarded as sufficient.

The pitch of threads must conform to the Briggs standard for pipe threads. The pitch of the thread (number per inch of thread), and the length of the threaded portion at each end must be as given in the accompanying table.

THREADS USED FOR CONDUIT TUBING

Electrical Trade Size, Inches	Number of Threads per Inch	Length of Perfect Thread, Inches	Total Length of Thread, Inches
¼	18	0.29	0.57
⅜	18	0.30	0.57
½	14	0.39	0.75
¾	14	0.40	0.76
1	11½	0.51	0.94
1¼	11½	0.53	0.97
1½	11½	0.55	0.98
2	11½	0.58	1.12
2½	8	0.89	1.51
3	8	0.95	1.57
3½	8	1.00	1.62
4	8	1.05	1.67
4½	8	1.10	1.72
5	8	1.16	1.78
6	8	1.26	1.89

Machinery

The taper of threads on conduit must not exceed ¾ inch per foot. The perfect thread must be tapered its entire length. Couplings must be tapped straight. The taper of the thread should not exceed ¾ inch to the foot. Smaller tapers may be used if desired by the manufacturer. It is desirable that the taper appear on the entire length of the perfect thread. When solid threading dies are used and the threads are cut too long, this condition is not obtained. When the length of threads does not vary from the nominal length more than 1½ threads (above or below) for sizes up to and including 2 inches, nor one thread for sizes above 2 inches, the resulting condition may be considered as acceptable, but should be called to the manufacturer's attention. When the total length of thread varies from the nominal length by more than the number of threads mentioned, the pipe should be rejected for conduit purposes, but may be sent back to be rethreaded.

MOTTLING PROCESS FOR MILD STEEL

A. J.—Please describe a process for obtaining a mottled effect on mild steel parts that can be employed for quantity production. Various methods using water, air, and different mixtures as given in text-books have failed to give the regular gray-blue to purple type of coloring desired. Is some method of coating the work previous to treatment applicable?

A.—For best results the pieces should first be polished. After polishing, all grease should be removed from the parts by boiling in a strong soda solution. The pieces are next heated in a cyanide bath to a temperature of about 1380 degrees F. A thermo-couple or similar heat-indicating device should be employed to insure that the temperature is maintained, but not exceeded. Care must be taken to avoid any tendency toward oxidation. The quenching bath should be agitated by an air pipe carried down inside the bath and turned upward about 6 inches from the bottom of the tank.

Quenching baths should consist of 6 pounds of potash (saltpeter), ¾ pound of permanganate of potash, 1 pound of cyanide of potassium, 2 pounds of common salt, and 4½ gallons of water. For best results, soft water should be used. The pieces, on being removed from the heating bath, are plunged immediately into the center of the stream of air bubbles coming up from the bottom of the quenching bath tank. The salt in the solution is important on account of its action in splitting up the surface of the mottling. The action of the air in the solution produces a somewhat globular type of marking.

To obtain a herringbone effect in the mottling, the pieces are quenched in the same part of the bath with a quick upward and downward motion of the piece, working it downward toward the bottom of the bath at the same time. To accentuate the colors, the work is finally boiled in oil for ten minutes, which also has the effect of adding permanence to the coloring.

TRAINING OF MECHANICAL DRAFTSMEN

By C. M. GOODIER

The article entitled "The Mechanical Education of a Draftsman," which appeared in September, 1923, MACHINERY, suggested to the writer that industrial executives might be interested in observations made during the last four years in a school devoted to training disabled veterans of the World War in mechanical drawing. It is generally accepted that the value of practical experience in machine operation cannot be overemphasized. Some industries get their draftsmen directly from the shop. Such a policy necessitates that the compensation paid the draftsmen exceed the rate fixed in the shop, and also that there be a sufficient number of shopmen qualified for the work in the drafting-room. Few men can immediately take up the work of the drafting-room efficiently or possess the ability to extract, independently, from technical literature the knowledge required.

To assist in the execution of a plan for general shop-to-drafting room transfer, an organized school, either public or private, seems necessary. The public evening schools, introduced to meet the particular needs of the worker, often fail because the instructors are drawn from day schools having mental training as the main objective. The adult student must swallow a bushel of chaff, from his point of view, to get a kernel of grain. This, his economic circumstances do not always permit.

The school to be considered in this article is a private school open to all, at nominal rates of tuition. Its work began in 1826, before the great modern schools of engineering had been conceived of, when there met in Baltimore "a few practical and unpretentious citizens" to hear lectures on science and to improve themselves in the mechanic arts. Later, as "manufacturers, mechanics, and artisans," they incorporated themselves as "The Maryland Institute for the Promotion of the Mechanic Arts," and under a board of directors, two-thirds of whom "shall be practical manufacturers or mechanics," organized a "school of design, adapted to mechanical, manufacturing, and scientific purposes, in which members of the institute may be taught the art of drawing and designing, a branch of education so necessary in every business and profession connected with the mechanic arts." During all the subsequent years, while other institutions of learning developed into magnificent universities, this school has remained true to its original purpose of meeting the needs of the "practical and unpretentious citizens." The course in mechanical drafting is offered three evenings a week, and is pursued largely by apprentices in the city's industries. Most of the students possess an education obtained in the public schools. Consequently, the course of four years is devoted mostly to drafting.

The particular department of the school to be considered was opened at the close of the war, when a part of the space occupied by the evening classes was given over during the day to the rehabilitation, in part, of the injured veterans. Most of these men had shop experience and were in a position to understand the details of the regular course in drafting as presented and explained. Their education in mathematics was limited, however, often to that of the sixth grade of the public schools—and that quite "rusty"; so it was found necessary to devote ninety minutes daily to mathematics. At the beginning, few aspired to go beyond arithmetic and a limited use of handbooks. The instructors were informed that algebra was too theoretical a subject for the men.

Gradually, however, the use of handbooks and certain problems on estimating and designing, taken directly from the shops, made clear to the men the desirability of applying formulas. They covered the fundamental operations of algebra, equations involving one and two unknowns, quadratics, radicals, and logarithms. The application of formulas was the objective; the men were taught that nearly any problem might be solved, provided the formula was given. The reader should bear in mind that the school objective was not to turn out engineers. The mastery of the application of formulas enabled the men to solve, shortly, such problems as come under applied geometry and trigonometry. For ordinary practical work, knowledge of about fifteen geometrical theorems is sufficient. Their application was considered, but proof of the statements made was limited to two or three.

Most educators in high-schools would affirm that practice in proving theorems is necessary for solving industrial problems such as, for instance, to find the area of an irregular groove for a rubber gasket, bounded by arcs and straight lines, which involves geometry and trigonometry. At one time the writer would have agreed with them. But in this work, economy of time permitted consideration of essentials only; and the results were surprising. Nearly all the men found little difficulty in solving and checking such problems after plane trigonometry was covered. The problems presented in MACHINERY were taken up primarily with the modest ambition to acquire the ability to follow the solutions intelligently. When members of the class began to submit original solutions, the magazine was used as a text. From this, chief draftsmen who find that their men are unable to solve routine problems, because they lack knowledge of trigonometry, may learn that the lack may be obviated in a comparatively short time. On the average, these men, who did but little independent outside studying, and whose attendance was irregular, due to taking medical treatment, acquired that ability within two years, three-fourths of which was devoted to the drafting board.

Next, machine stresses, strength of materials, design of machine details, and of structural members and trusses, using graphic and component methods, were covered. Practice in the use of the slide-rule, short-cuts and reviews, completed the work in mathematics. The scope deemed at first necessarily to be quite limited, developed to meet, to a high degree, the requirements of the industrial drafting-room in which the men would be placed for the first few months as understudies.

It is not maintained that the success of the work is unqualified. Those men who were attracted to school by the immediate monetary compensation only, or who felt that the nation owed them a living and had not discovered that the most satisfactory palliative for human ills is creative work, did not accomplish the objective fully. But those whose lack of training had been due to economic conditions, and whose real ambition was to pursue mechanical drafting and designing, succeeded without exception.

The results suggest the feasibility of rehabilitating, to a greater extent, the army of men disabled annually for physical work in industrial shops, as well as those wounded in the war. The observations in the foregoing seem to indicate that the practical essentials of mechanical drafting and designing may be assimilated by the adult within a comparatively short space of time.

* * *

TEN YEARS' RISE IN WAGES

Bulletin No. 354 of the United States Department of Labor, relating to the union scale of wages and hours of labor of nearly 900,000 union members in the United States on May 15, 1923, and showing comparison with preceding years, has just been issued by the Department of Labor through the Bureau of Labor Statistics. The bulletin contains returns from 66 leading industrial cities, and 12 groups of industries covering 89 trades or occupations. In the average for all trades, taken collectively, the hourly wage rate on May 15, 1923, was higher than in any preceding year, being 9 per cent higher than on May 15, 1922; 84 per cent higher than in 1917; 111 per cent higher than in 1913; 123 per cent higher than in 1910; and 135 per cent higher than in 1907. In 1923 the regular hours of labor were at the same level as in 1922; 4 per cent less than in 1917; 6 per cent less than in 1913; 7 per cent less than in 1910; and 8 per cent less than in 1907.

Tools and Fixtures for Turning Eccentrics

By F. H. MAYOH

THE man who has had little or no experience in machining eccentric parts often encounters some perplexing problems when confronted with this kind of work. This is true whether only a few pieces are to be made or large quantities are to be manufactured. Similar methods of handling the work are used in either case, except that in manufacturing large quantities special fixtures may be employed, which will materially speed up the work. The purpose of this article is not so much to describe elaborate tooling methods as to point out methods to be used under different conditions.

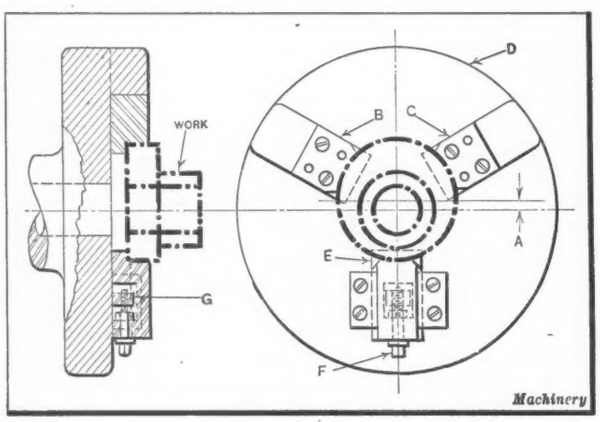


Fig. 1. Chuck for Eccentric Turning and Boring

Turning Eccentric Bushings

A job often encountered is that of turning bushings that have one portion eccentric with another portion of a different diameter, as indicated in Fig. 1, where the part having the larger diameter is eccentric with the hole and the smaller portion. This part is made from a solid disk. The large portion is first turned to the required diameter in the usual manner, after which the work is put in the chuck or fixture shown, which holds the larger portion eccentric with respect to the center of the machine spindle. When held in this manner, it is a simple matter to drill the hole and turn the smaller portion to the required diameter so that it will be offset an amount equal to that indicated by the dimension *A*.

In this fixture two plain jaws *B* and *C* are attached to the lathe faceplate *D* by means of screws and dowels. The jaw *E* can be adjusted by means of screw *F*, which is threaded to fit the tapped hole in lug *G*. This lug is made a permanent part of the faceplate *D*, and each piece is clamped in place by tightening screw *F*. While this faceplate is of special construction, it is essentially a three-jaw chuck built to hold work having a definite offset or eccentricity, the amount of offset being positively determined by the position of jaws *B* and *C*. An independent three-jaw chuck could be used in the same manner by setting two of the jaws so that they would provide for the correct amount of offset, in which case the third jaw would be marked and the clamping done by means of this jaw alone. This method would be sufficiently accurate for most purposes, and the jaws could be reset for different jobs.

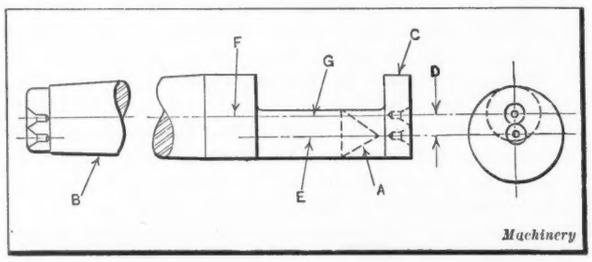


Fig. 3. First Operation in turning an Eccentric Center

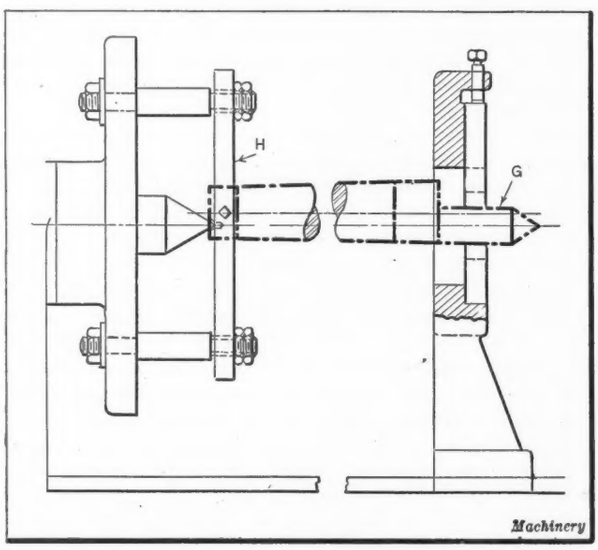


Fig. 4. Set-up for pointing Eccentric Center

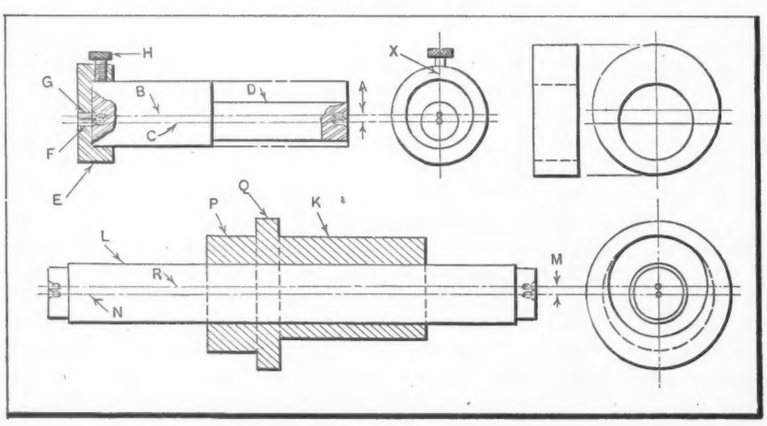


Fig. 2. Arbors with Two Sets of Centers for Eccentric Turning

Arbors for Eccentric Turning

In the upper right-hand corner of Fig. 2 is shown a ring with the hole eccentrically positioned with respect to the periphery. The work of drilling and boring the eccentric hole could be performed in the manner illustrated in Fig. 1. In the upper left-hand corner of Fig. 2 is shown a shaft having an eccentric section *D*. The eccentric portion of this shaft is turned by drilling an extra pair of center holes so that there are two pairs of centers located on lines *B* and *C*, respectively, the distance between these

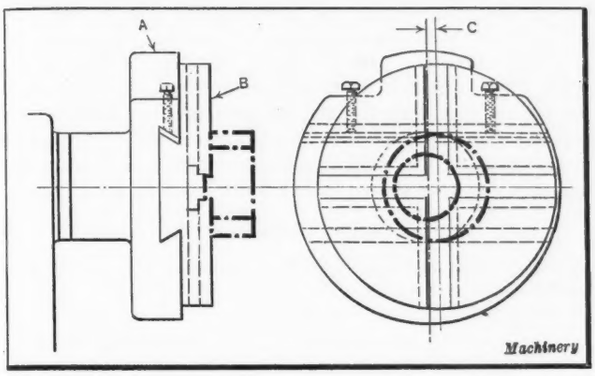


Fig. 5. Faceplate equipped with Sliding Clamping Plate

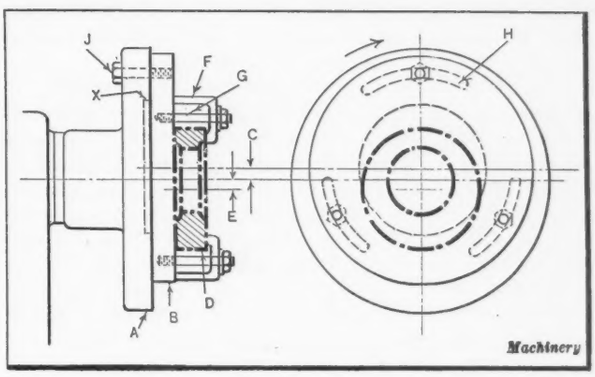


Fig. 6. Adjustable Faceplate Fixture for Eccentric Boring

lines being indicated by dimension *A*. In machining the large section, the work is mounted on the centers on line *B*, and a dog used to drive it. The small section *D* is turned by mounting the arbors on the centers on line *C*.

A simple jig *E* is employed in drilling the centers on lines *B* and *C*. In using this jig, a line is first scratched along the periphery of the work, and the jig clamped in position by means of a knurled screw *H* with the line *X* matching the line scribed on the work. The two center holes are then drilled in one end of the work, using jig *E* to guide the drill. The jig is next transferred to the opposite end of the work and lined up with the scribed line, for drilling the two remaining center holes. The four center holes are then countersunk, after which the turning operations are performed as previously described. This is an accurate method, but many jobs do not require such a high degree of accuracy; in such cases, the holes can be laid out to scale measurements and drilled and countersunk with a combination center drill.

At *K* is shown an eccentric bushing mounted on an arbor *L*. It will be noticed that two pairs of center holes are drilled in this arbor also. The portions *P* and *Q* are turned to the required diameters while the arbor is held on the centers on line *N*, and the eccentric portion *K* is turned by mounting the arbor on the centers on line *R*. It is necessary that care be taken (in turning bushings of the eccentric type) to see that the work does not slip on the arbor. The usual practice is to rough-turn every bushing, and then finish-turn, using light cuts in order to insure accuracy. It is obvious that the work must not be removed from the arbor between the roughing and finishing operations unless a line is scribed on the end of the work to correspond with a line scribed on the periphery of the arbor, so that the bushing can be accurately relocated for the finish-turning operations by having these two lines match.

Making an Eccentric Center for Turning Tapers

The two important steps in the production of an offset or eccentric center for use in turning tapers are illustrated in Figs. 3 and 4. The pointed end of the center indicated by the dotted lines at *A*, Fig. 3, together with the portion *G* is machined eccentric to the tapered portion *B*. This center provides a means of turning tapers without setting the tailstock over, but it is sometimes used when the tailstock cannot be set over a sufficient amount to provide for turning the steep taper required.

After the center is turned to the shape indicated in Fig. 3, the end *C* which provides for turning the eccentric portion is cut away by mounting the work on a lathe, as shown in Fig. 4. The set-up shown should not require any description. An ordinary lathe dog could, of course, be used in place of the driving bar *H*. This set-up is also used for grinding the conical point of the center after it has been hardened.

Adjustable Eccentric Turning Fixture

In Fig. 5 is shown a fixture that can be adjusted to vary the amount of eccentricity of the part being turned. It consists essentially of a faceplate *A*, attached to the lathe spindle, and a plate *B* which is secured to the faceplate by means of a dovetail joint. The sliding member can be offset so that any work centered and clamped to its face can be turned to any degree of eccentricity *C* within the capacity of the fixture. The plate *B* is provided with T-slots to

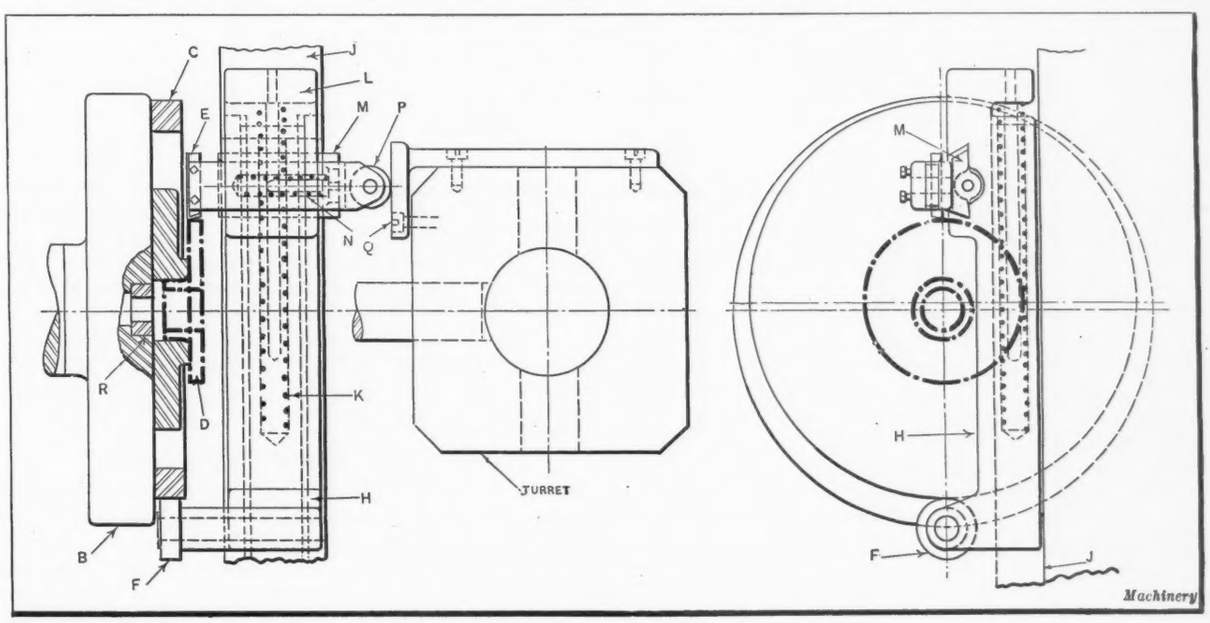


Fig. 7. Eccentric Turning Attachment used on Turret Lathe

accommodate hold-down bolts, and is used to a considerable extent for boring eccentric holes in plates and for drilling a series of holes in sheet-iron or steel plates.

A fixture intended for the same kind of work but constructed in a somewhat different manner is shown in Fig. 6. In this case the faceplate *A* which is attached to the lathe spindle has a revolvable work-holding plate *B* secured to its face. The shoulder or projecting portion *X* on plate *B* fits in a recess machined in plate *A*. This recess is bored eccentric with respect to faceplate *A*, the amount of eccentricity being indicated by dimension *C*. The work *D* to be machined is held in place on plate *B* with an offset indicated by dimension *E*. By loosening studs *J* and revolving plate *B* on plate *A*, any degree of eccentricity can be obtained within the limitations imposed by the slots *H*. Clamps *F* and hold-down studs *G* are provided for clamping the work to the plate *B*.

The turning devices that have been described in the preceding were designed for use with engine lathes. But the device illustrated in Fig. 7 is employed for eccentric turning in a turret lathe. The boring and reaming tools used for machining the hole in the eccentric part shown at *D* are illustrated in Fig. 8. These tools are part of the equipment made up especially for use with the fixture. Besides providing a means of turning eccentric work, the fixture shown in Fig. 7 can also be used for turning or machining face cams. The ring *C* attached to the face of chuck *B* controls the in and out movement of the tool through contact with the roller *F* mounted on block *H*. Ring *C* must, of course, be properly machined to give the flange *D* the required contour.

Block *H* slides on a support *J* attached to the cross-slide of the chucking machine. In this support is mounted a spring *K* which contacts with a boss *L* located on the sliding block *H*. Block *H* is held to the support by means of the usual type of dovetailed slide. The purpose of spring *K* is to keep roller *F* in contact with ring *C*. The tool *E* is held in slide *M* which, in turn, is mounted in the sliding block *H*. The longitudinal feeding movement of tool *E* across the flange of the work is effected by feeding the turret forward so that the face of the angle-plate *Q* comes in contact with the roller *P* mounted at the right-hand end of slide *M*. Spring *N* serves to keep roller *P* in contact with plate *Q*. The bushing *R* in the faceplate supports the pilot *S* on the end of the rough-boring bar shown at *T*, Fig. 8, and also the pilot on the finish-boring bar.

In machining the part *D*, Fig. 7, the hole is first rough-bored, after which it is finish-bored by the small pointed tool shown at *A*, Fig. 8. The finish-boring operation is performed simultaneously with the eccentric turning operation on the flange. The final operation is that of reaming the hole with the tool shown in the lower view of Fig. 8.

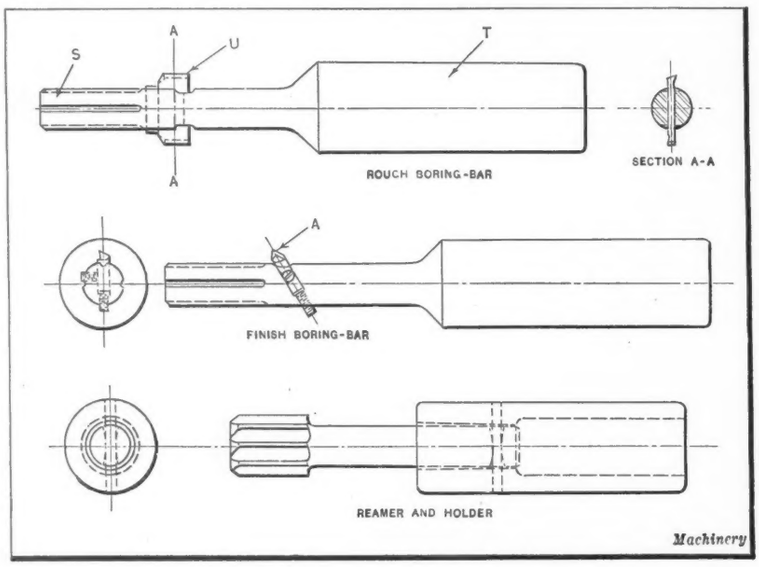


Fig. 8. Boring Tools and Reamer used with Attachment shown in Fig. 7

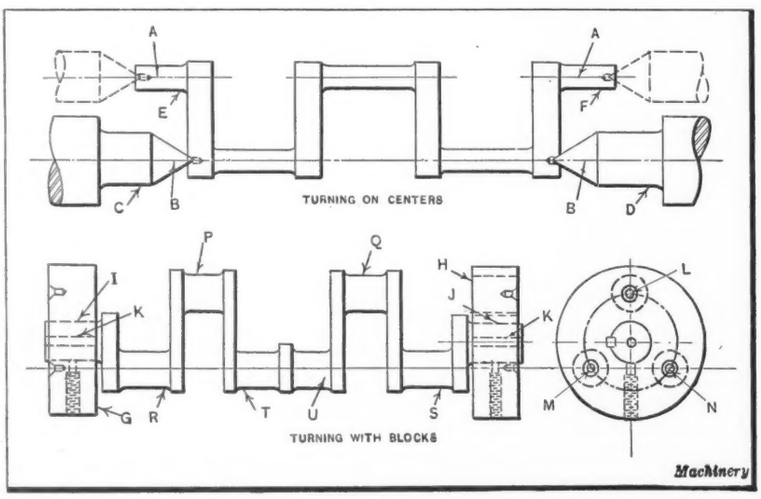


Fig. 9. Methods used in turning Crankshafts

Turning Crankshafts

Two methods of supporting crankshafts (which represent another form of eccentric turning) are shown in Fig. 9. The arrangement shown in the upper view necessitates centering the work on the two lines *A* and *B*. The lathe centers are employed in the usual manner, as indicated by the dotted lines, when turning the surfaces that are concentric with the center line *A*. In order to turn the surfaces that are concentric with line *B*, a special pair of centers *C* and *D* are used which extend out beyond the spindles of the machine far enough to permit the ends *E* and *F* to clear the faceplate and the tailstock, respectively.

A more common method of turning eccentric cranks is shown by the lower view in Fig. 9. The two blocks *G* and *H* are mounted on the ends *I* and *J* of the work, which have previously been centered and turned in the usual manner. The blocks *G* and *H* are properly located by keys *K*. Three sets of center holes, *L*, *M*, and *N* are provided in the blocks to correspond with the 120-degree spacing of the cranks. When the crankshaft is mounted on centers *L*, the surfaces *P* and *Q* are turned, and when it is mounted on centers *M*, surfaces *R* and *S* are turned, while surfaces *T* and *U* are turned when the centers *N* are employed. Projecting pins located in the faceplate of the lathe are used to drive the work. Counterweights are generally secured to the faceplate, in order to balance the work so that it will run smoothly.

Cam-operated Eccentric Turning Device

In Fig. 10 is shown a device used in turning the eccentric member *B* on a small piece of work held in the collet *A*. On the end of the machine spindle is mounted a faceplate *C* which has an eccentric groove *D* cut in its face. Engaging groove *D* is a roller *E* which is mounted on a stud *F* held in a block *G*. The block *G* slides on the cross-slide *H* of the

lathe or chucking machine, which is clamped in a fixed position. As the faceplate revolves, it causes block *G* to travel in and out. On block *G*, and firmly secured to it, there is a tool-carrying block *L* which may be fed forward by means of the handle *K* secured to screw *J*. The forming tool can therefore be fed into the work as slowly or as fast as the operator desires.

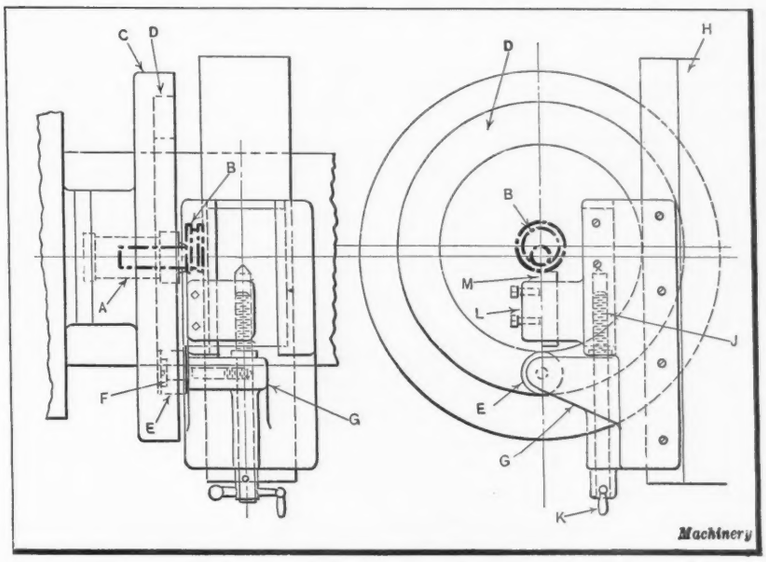


Fig. 10. Cam-operated Eccentric Turning Attachment

The principles embodied in the design of eccentric turning attachments employed by various manufacturers of chucking machines are shown by the diagram Fig. 11. The location of the shaft *K* and supporting bar *X*, as well as other members of the device, might be somewhat different in actual practice, the purpose of the diagram being merely to show the general lay-out.

The arm *E* which supports the tool-slide *R* is attached to the turret. The in-and-out movement of the tool-slide required to turn the eccentric portion of the work is obtained by means of a cam *N* which is keyed to shaft *K*, but free to slide on it. Shaft *K* is driven at the same speed as the lathe spindle by means of gears *G*, *H*, and *J*. The spring *T* serves to keep the roller *P*, mounted on the tool-slide *R*, in contact with the cam *N*. From the illustration it will be clear that when the spindle is revolving, the portion *A* of the work will be turned eccentric with respect to the part held in the chucking jaws when the turret-carrying arm *E* is advanced.

In conclusion it may be well to call attention to the fact that the devices shown in Figs. 7, 10, and 11 can be used for turning irregular shapes such as are required for face-cams when the roller grooves, rings, or shape-controlling pins are cut to the required shape.

* * *

EXPORTS OF AUTOMOBILES

The exports of automobiles are constantly increasing. The total number of passenger cars and trucks exported now exceeds 18,000 a month, of which over 15,000 are passenger cars. If exports at the present rate are maintained throughout the year, the total number of passenger cars exported this year will reach 165,000 and the number of trucks nearly 30,000, which figures considerably exceed those of 1923. The exports at present are about 8.5 per cent of the total production of passenger cars and trucks.

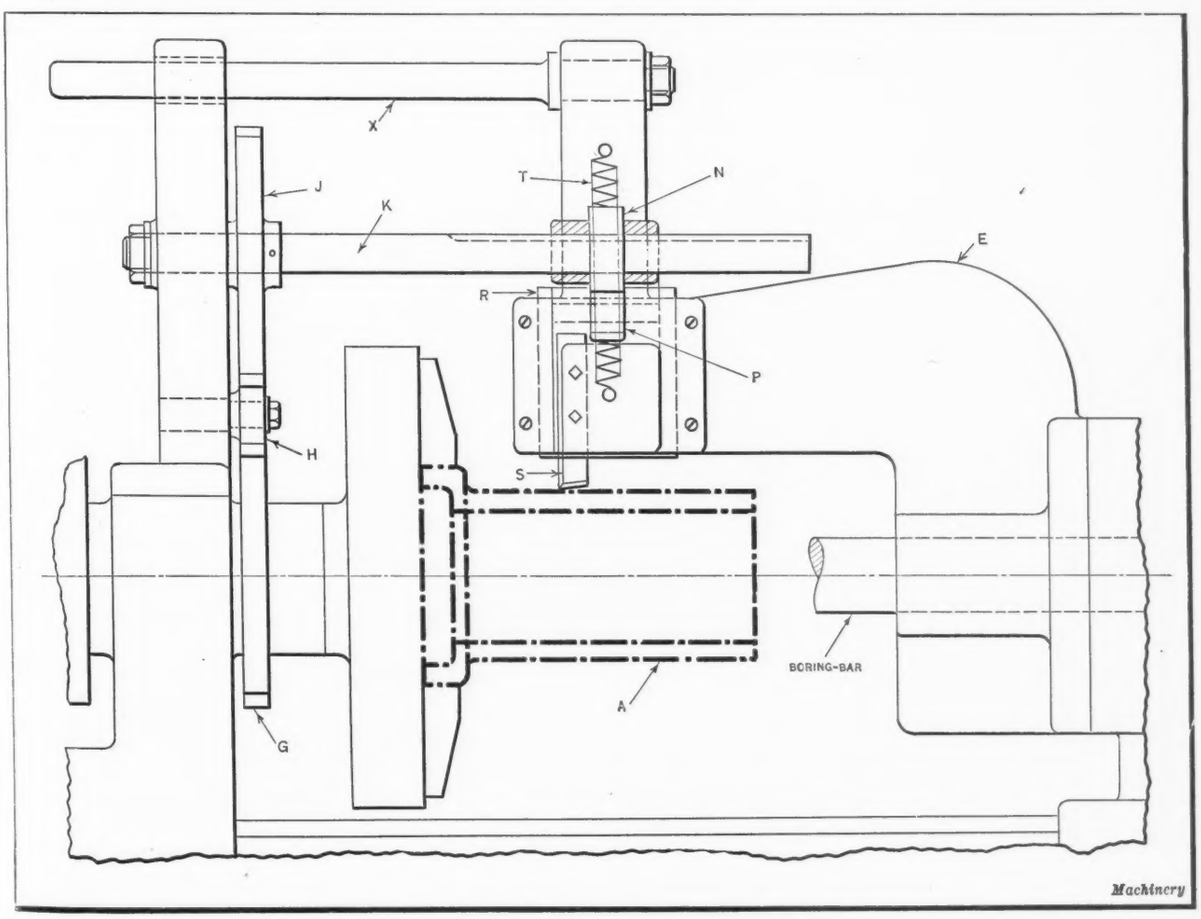


Fig. 11. Type of Eccentric Turning Device used on Chucking Machines

GEARLESS VARIABLE-SPEED TRANSMISSION

There are any number of machines and mechanical units that varying circumstances make it desirable to be able to drive at a barely perceptible speed, an intermediate speed, or a high speed. The latest variable-speed unit of this type to be placed on the market was recently patented by the Driscoll Transmission Corporation, 416 W. 33rd St., New York City. A feature of this unit is that while its operation is entirely mechanical, any speed from zero to maximum is obtainable without the use of a single gear. The changes in speed are made without shocks or undue stresses. This transmission has a wide application in the field of machine tools and conveyors, and may serve as a substitute for the prevailing types of automobile transmission. In an automobile, the unit would dispense with friction clutches, gears, and the differential.

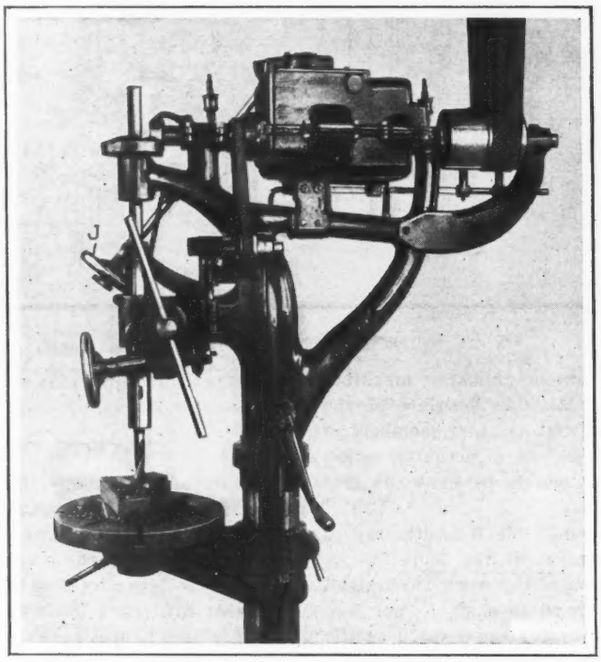


Fig. 1. Upright Drilling Machine equipped with a Gearless Variable-speed Transmission

Fig. 1 shows the mechanism installed on the main driving shaft of an upright drilling machine to provide an unlimited number of speeds and feeds, and Fig. 2 shows an assembly drawing of the unit. The drive is delivered to the transmission by shaft *A* on which tight and loose pulleys are mounted. The shaft, of course, may also be driven direct by motor or other means. Two cranks on shaft *A* impart motion through connecting-rods *C* to oscillate a shaft *D* on each side of the transmission. At the forward end of each of these shafts is a crank *E* in which there are two blocks *F* which are adjustable along grooves in the crank. It will be seen that the blocks in each crank are connected by means of the link *G* to another crank *H* which is bushed on the shaft *B*. The position of blocks *F* on cranks *E* is adjustable by turning handwheel *J* to raise or lower screws *K*, which are each connected by means of a link to the respective blocks *F*. The pairs of blocks on the opposite sides of the transmission are adjusted in unison by sprocket *L*, mounted on the same nut as handwheel *J*, which drives sprocket *M* through a chain. Instead of these sprockets and chain, screws *K* are sometimes connected by means of a shaft and helical gears. Then, too, instead of handwheel *J* being mounted directly on the nut of one of screws *K*, the handwheel may be placed in a convenient position for the operator, as shown in Fig. 1, and connected to the nut by a long shaft and bevel gears.

It will be evident that at each revolution of shaft *A*, cranks *E* are rocked once forward and backward, with the result that cranks *H* oscillate similarly. The angular movement of cranks *H* becomes less as blocks *F* are moved from the extreme end of cranks *E* toward the axis of the cranks. When the center of the blocks coincides with the axis of the cranks, no movement is imparted to links *G* and cranks *H*. Integral with each crank *H* are two eccentrics which impart radial movements to two impeller parts. These serve as a quick-acting clutch to transmit the drive to drums *N* when they are expanded. Drums *N* are both keyed to shaft *B* to drive it when they are rotated, both drums being turned in the same direction. The two drums are engaged simultaneously so as to obtain a double drive. The impeller devices consist of an ingenious design in which rollers are employed with the double eccentrics to give the quick locking and unlocking action.

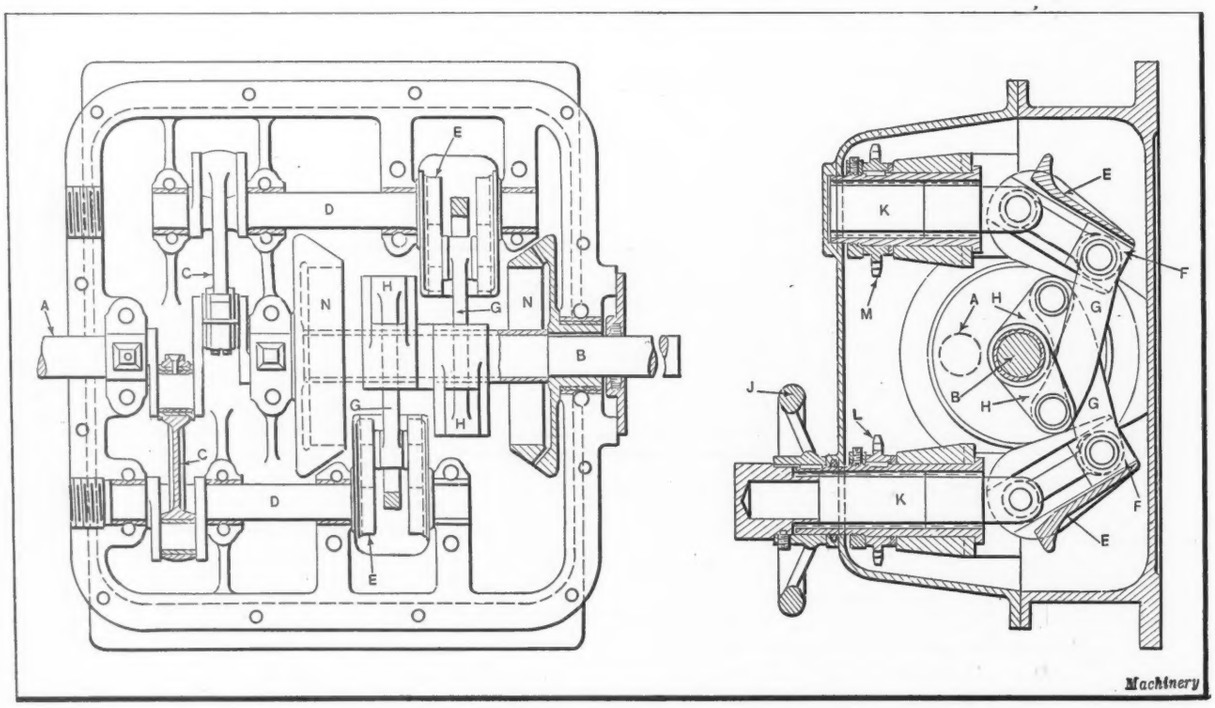


Fig. 2. Assembly Drawing showing the Construction of the Variable-speed Transmission

From the foregoing description it will be obvious that with a machine equipped with this transmission in the main drive, it is possible to obtain any conceivable feed or speed between zero and maximum of the tool or work. With a speed of, say, 1150 revolutions per minute of shaft *A*, the maximum speed of shaft *B* would be about 800 revolutions per minute. In another type of this transmission, the drive may be reversed at will. The housing is oil-tight, dust-proof, and filled with lubricant which is copiously supplied to all parts by the splash obtained from the movement of the cranks, etc.

* * *

GROUND TAPS AND SCREW THREAD FITS

By HARRY S. BEAL, Assistant General Manager
Jones & Lamson Machine Co., Springfield, Vt.

The recent development of ground thread taps and dies, and of adequate screw thread gaging machines, has made it possible to produce, on a commercial basis, screw thread fits to a very close degree of accuracy. Now that these results are practicable, the quantity manufacturer begins to ask himself questions about the cost of the added accuracy and its necessity.

A cylinder, to be a wringing fit in a round hole, must be made very close to the exact diameter, and must be uniformly round and straight. A screw to go into a threaded hole must be all of this, and besides the angle of its flanks must be correct, the root must be cleared below the basic size, and the lead must be accurate. We know that to make a screw fit exactly into a threaded hole with all of those complications of dimensions is expensive. Therefore we ask ourselves if all screw threads must be close fits; and, if not, which dimension may safely be allowed to vary.

The screw thread has two major uses: (1) To transmit motion or power in mechanisms; and (2) to act as a fastener to hold two parts together. Screws for the first purpose, such as are used in micrometer heads, must be accurate, but may be dismissed from our thought, as they constitute a minority of screws cut commercially. Of the second class there are a few cases, such as studs in automotive construction, that must be a wrench-tight fit in the threaded hole. The great majority of this second class of screws and of all screws made commercially, however, are used merely to bind together two separate parts. Such an average screw thread has two requirements: (1) When tightened, it must remain tight and not work loose; (2) sufficient surface must be in contact so that the tensile strength of the screw threads is greater than the tensile strength of the smallest cross-section of the body of the screw.

A study of screw thread engagement shows us that in the great majority of cases the screw must be a fit in the nut only when it is tightened. In other words, all right-hand flanks on the screw must fit with left-hand flanks in the nut when end pressure is applied. It will be seen then that the lead and shape of the thread must be accurate but that the pitch diameter may vary within reasonable limits.

There are three different conditions that may arise in the fit between a screw and a nut; these are:

1. A perfect screw fitting in a perfect nut.

2. A screw with perfect lead fitting in a nut with perfect lead, but with a difference in pitch diameters. In this case, all the right-hand flanks, for example, on the screw, will fit the left-hand flanks in the nut, but on the opposite side of the thread there will be a clearance space. Laboratory experiments show that with a 60 per cent engagement of the screw in the nut, if both have correct lead, the body of the bolt will fail before the threads strip. It should be noted, furthermore, that with perfect lead in both screw and nut, a 60 per cent engagement between the threads on one side is sufficient to hold the screw tight under pressure, even in case of severe vibration.

3. Perfect lead on the screw, but lead too long in the nut, and a difference in pitch diameters. In this case the lead error may be so great as to prevent the screw from fully entering the nut, unless the metal "flows." To overcome the effect of the incorrect lead in the nut, it is necessary to reduce the pitch diameter of the screw to compensate for the lead error. In a case of this kind, however, when the nut is tightened, a small section of the thread bears the whole load. Under strain or vibration the thread is likely to strip and the screw to loosen.

The examples mentioned demonstrate the fact that in ordinary screw thread fits, accurate lead is vastly more important than accurate diameter. In fact, for a safe screw thread fit, the lead must be accurate, while the diameter tolerance may be large enough so that it does not prevent in any way the fastest production methods. Screw thread fits have long been considered more complicated and difficult of attainment than plain cylindrical fits. To make two members with serrated profiles fit each other is surely more difficult than to fit a cylinder into a hole. However, when the requirements are closely examined, it will be seen that if we have lead accuracy, good screw thread fits may be secured with far greater diameter tolerances than is permissible in the case of cylindrical fits.

The unground tap or die cannot be made with accurate lead owing to the change of the steel in heat-treatment. When the tap or die is ground after hardening, the lead can be made very accurate. Its diameter may also be held as close as is desired. A tolerance of 0.0015 inch is close enough for the majority of work, and is sufficiently great so that the grinding operation could not be cheapened by a greater tolerance.

The contributions of thread grinding to the art of cutting screw threads are: (1) Accurate shape; (2) accurate lead; (3) as accurate diameter as is necessary; (4) uniformly shaped and spaced cutting edges; and (5) effective use of high-speed steel for thread-cutting tools.

The company with which the writer is connected has adopted commercial limits for the ground taps manufactured. These limits are intended to fit the needs of the ordinary manufacturer. The lead is held to within plus or minus 0.0005 inch per inch. The pitch diameter is made between the limits of basic diameter plus 0.0005 inch, and basic diameter plus 0.002 inch.

It would not be of much value to be able to produce an accurately threaded hole with an accurate tap, if the screws to fit the holes could not also be produced with accurate dies. For that reason, die chasers should also be ground in the thread after hardening. This makes it possible to produce both screws and tapped holes that will be very accurate, both in regard to lead and shape of thread.

* * *

WARNING AGAINST CIVIL SERVICE "SCHOOLS"

The United States Civil Service Commission and the National Vigilance Committee of the Associated Advertising Clubs of the World have issued a joint warning against misleading advertising of many so-called "civil-service coaching schools." The following points are emphasized: (1) No "school" of this kind has any connection whatever with the Civil Service Commission or with any other branch of the Government. (2) No school can give advance information regarding examination questions. (3) No school can furnish civil-service information of value which cannot be obtained without cost from the Civil Service Commission at Washington or its representative at the post office or custom house in any of approximately 3500 cities. (4) No school can "guarantee" appointment in the classified civil service. Appointment can be secured only through open competitive examination under the civil-service rules. No school can cause a competitor to be certified for appointment out of the regular order, which is determined by his examination rating only.

The Civil Service Commission states that large numbers of applications for examination received at its office indicate that many civil-service schools accept as clients and take money from practically illiterate persons who could not possibly pass any kind of examination.

The Machine-building Industries

WE have become so used to measuring business conditions by comparison with record-breaking figures of the past, that we all lean toward pessimism when past records are not maintained or excelled. While there has been a considerable slump in most lines of business, compared with a year ago, production has not stopped by any means, and if, instead of comparing with the peaks of the past, we compare with the average of a number of years, the situation does not seem so serious after all. The presidential nominations are over, and many people consider the outcome of the election a foregone conclusion; that being the case, there should be no hesitancy on the part of industry because this happens to be a presidential year.

Production has declined to a point about 18 per cent below the highest peak ever reached, the largest reductions being in the textile, iron and steel, and leather industries. Much has been said about the reduction of output in the automobile industry, but when the monthly output of passenger cars and trucks exceeds 250,000, which is equivalent to a rate of 3,000,000 cars a year, that industry is certainly not at a standstill. As a matter of fact, the total output for the first six months of 1924 was at the same rate as the output during 1923—the record-breaking year.

Car loadings are about 10 per cent below what they were a year ago, and this is about as accurate an index as it is possible to obtain of the actual business done in the country. It is significant that a reduction of 10 per cent in the total business practically makes the difference between a feast and a famine.

The Machine Tool Industry

There has been very little change in conditions in the machine tool field. During the past month there has been no great activity either in orders or inquiries, and most of the domestic business placed was for single machines, with the exception of a few orders from the automobile industry for new equipment. One of the large corporations in Japan has placed a number of fair-sized orders for machine tool equipment, and there has also been some demand for machine tool equipment for Mexican railroads. None of this business, however, has been sufficient to prevent the industry as a whole from curtailing its output until a more brisk demand manifests itself, as is confidently expected in the fall.

Pending this upward turn, progressive machine tool builders are actively engaged in missionary work. For they recognize that manufacturers in general are interested in equipment that means, ultimately, greater economy, even though they may not be in a position to purchase at the present time. This applies not only to machine tools of special and "single-purpose" types but to the more standard designs, assuming in each case that they possess features which are particularly attractive from the user's viewpoint. Instead of waiting, some of the more optimistic executives believe in buying now when orders can be filled promptly, thus avoiding costly delays later when this modern equipment will be essential in supplying future demands for manufactured products.

The Iron and Steel Industry

The hesitating attitude of industry in general is best shown by conditions in the iron and steel field. Orders on the books of the steel mills warrant only a greatly reduced schedule of operation. There has been some decline in prices, but as yet these have not had the effect of stimulating new business. No one is buying for future requirements, because orders now placed can be quickly filled; and apparently buyers expect no change in prices, at least not in the direction that would make it advisable to cover future needs. Steel production for the entire industry is now about 40 per cent of capacity. The most hopeful view in the industry is that stocks in consumers' hands are being so depleted that when buying starts it will very soon bring about capacity business in the mills.

The pig iron trade is more active, and fair orders have been placed recently, as consumers evidently are deciding that present prices of pig iron are very attractive, since they are the lowest in two years and considered to be well below the actual cost of production. There has even been a scarcity in some sections of the country of certain grades of pig iron, because so many purchasers decided to buy at once, when the price reached what they believed to be the lowest level.

A number of furnaces have been blown out during the last three months, but the number blown out in June was less than half of those blown out during April and May, respectively, indicating that the industry is again reaching an equilibrium. Production of pig iron in May, the last month for which complete statistics are available, was about 30 per cent less than production for the same month a year ago, when it reached nearly a record figure.

In the malleable castings field, the output in May was 46 per cent of the total capacity of the plants. It should be noted, however, that the plant capacity is considerably above any normal demand, as the output has not exceeded 67 per cent at any time during the entire past year. Gray iron and steel foundries are operating at from 50 to 70 per cent capacity.

The Automobile Industry

Although complete figures for the output of automobiles in June are not available when this is written, it is quite certain that the output was considerably less than for May, when 280,000 passenger cars and 33,300 trucks were built. The May output was less than for April, but it should not be overlooked that the output of passenger cars and trucks during May exceeded 300,000, which is at an annual rate of over three and one-half million cars, a number surely not to be considered as indicating a very severe depression. While production of automobiles has been reduced because of big stocks, sales are reported to have increased steadily during the last three months, especially in the Middle West. Exports of automobiles from the United States continue to increase, and have now reached a point where they are 8 per cent of the total output.

Industrial employment in Detroit is stated to be about 20 per cent below the peak early in the year. Present prospects are that stocks will be sufficiently reduced on account of the decreased output of the factories, so that beginning with August, a more satisfactory manufacturing schedule can be maintained. The Studebaker Corporation is reported to have added men to its payroll during July, and is expected to reach the peak of its 1924 production in October. Ford sales during May and June were said to exceed production, and stocks in dealers' hands were well depleted by the end of June in most parts of the country. During May 868 Lincoln cars were delivered by the Ford Motor Co. This is the highest total in output of Lincoln cars in any one month. Retail sales of Fordson tractors averaged about 300 a day in May.

In spite of all the talk about a slump in the automobile business, let it be remembered that the total output of automobiles and trucks during the first six months of the year exceeded 2,000,000, which is equal to half the annual output in 1923, which was the record year in the industry.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Besly Semi-automatic Ring-wheel Grinding Machine

The No. 6 double-spindle wet ring-wheel grinding machine built by Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill., is shown in the accompanying illustrations equipped with a semi-automatic rotary work-feeding device for grinding cast-iron valve-sleeve parts. Another feature of this machine is a special micrometer adjustment on each spindle. The machine is direct-connected motor-driven, and is furnished with 18-inch ring wheels. The motors are of 7½ horsepower capacity, totally enclosed and equipped with special end castings. They are attached to bedplates, which are adjustable along the bed of the machine by means of a rack and pinion mechanism. The motor bedplates are mounted on machined V-ways on the main bed. There is also a large machined pad on the front of the bed provided with a T-slot for attaching the various fixtures used on the machine. For wet grinding, a cast-iron water pan is built in between the floor-supporting stands and the bed casting. This construction adds to the rigidity of the machine. When set in the working position, each head can be securely clamped to the bed by three anchor bolts. The motors are equipped with automatic push-button control, each motor being supplied with a separate starter. The starters are mounted in a row directly over the motors, and the push-button stations are located conveniently for the operator.

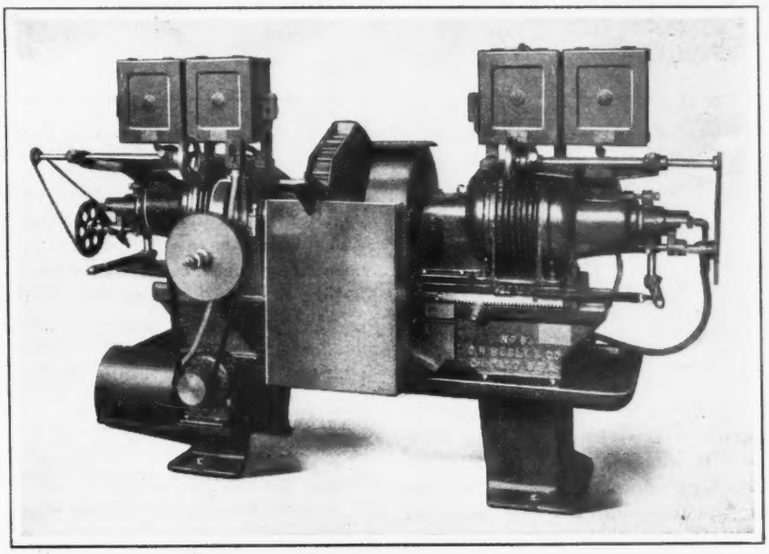


Fig. 1. Besly Double-spindle Motor-driven Semi-automatic Ring-wheel Grinding Machine

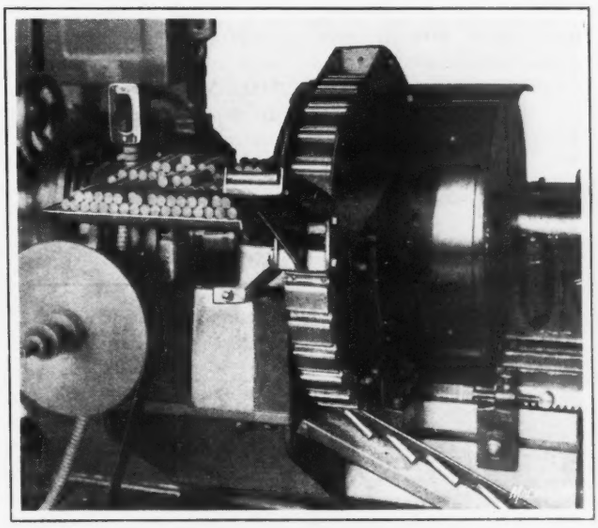


Fig. 2. Special Rotary Work-feeding Device

The spindles run in automatically oiled phosphor-bronze bearings. End thrust is taken by hardened steel thrust collars, and the back thrust is taken by ball bearings. The bearings may be moved endwise in the motor casings, the outer end of the bearing bushings being provided with rack teeth which mesh with pinions. The spindles are held in position by coil springs which function through levers and pinions. The micrometer adjustment of each spindle is made from the front side of the machine by operating the handwheels.

Cooling lubricant is delivered to the grinding wheels by a motor-driven pump attached to the base under the water pan. The lubricant is drawn from a 30-gallon three-compartment settling tank, and forced through piping connected to the outer end of the machine spindles. These are bored for the entire length, so that the lubricant pours on the work from the center of the spindles and is thrown by centrifugal force out against the work.

The feeding fixture, which is clearly shown in Fig. 2, is driven by a ¼-horsepower motor. The feeding wheel is provided with hardened steel bushings that accommodate valve-sleeve parts 11/16 inch in diameter and 2 7/8 inches long. The work is fed into the chute by the operator, picked up by the feeding wheel, carried through the guides to the grinding wheels and down between the wheels, and finally dropped out at the bottom on the screen chute. The parts leave the wheels with both ends finish-ground. A bar or guide lined with heat-treated steel which is machined to conform to the feeding wheel is secured between the grinding wheels to hold the work in place while grinding. It is stated that in removing not over 1/32 inch of stock from each end, work can be held to limits of plus or minus 0.002 inch and ground at the rate of 3200 pieces per hour. In addition to this operation, the machine will lend itself to similar work.

A grease-lubricated wheel-truing device is attached to the rear of the machine base. This device has a screw adjustment parallel with the spindles. A detachable cover is provided in the water hood to permit the cutter-bar to enter between the wheels. In a dressing operation, it is necessary to move one head back, and a stop is provided on the front of the machine to facilitate resetting the head after truing. The grinding wheels are 4 inches thick, have holes from 9 to 15 inches in diameter, and are carried in pressed-steel chucks.

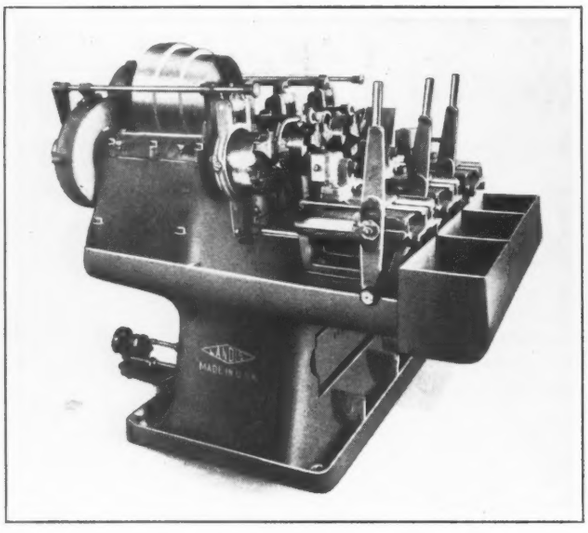


Fig. 1. Landis Threading Machine designed for producing Bolts in Large Quantities

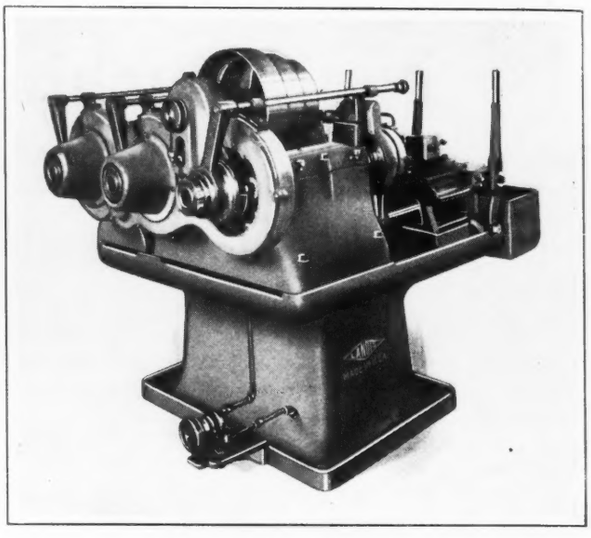


Fig. 2. Rear View of Threading Machine, showing Clutches for controlling the Spindles

LANDIS BOLT-FACTORY THREADER

A new thread-cutting machine designed for use in bolt factories, railroad shops, and other plants where a high production of bolts is required, has just been placed on the market by the Landis Machine Co., Inc., Waynesboro, Pa. The machine is built in 1- and 1½-inch sizes, in double- and triple-head types and also in a 2-inch size in the double-head type.

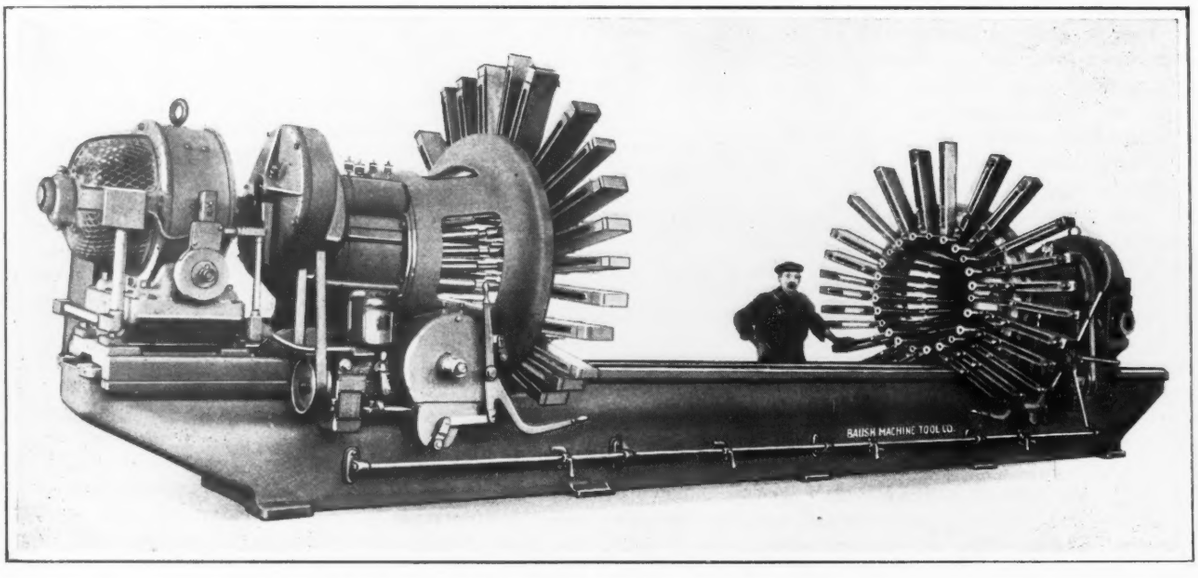
The spindles are located sufficiently close together to permit an operator to handle a three-head machine without shifting from one lever to another. The spindles are independent and controlled by clutches located at the rear as shown in Fig. 2. These clutches are operated by means of the bars extending over the die-heads to the front of the machine. Any head may be stopped without shutting down the others.

The die-heads are opened and closed automatically by stop-collars on tripping rods which connect the carriages to the yoke of the die-heads. These collars are conveniently and quickly adjusted to suit various lengths of threads. The carriage drive is in the center, and comprises a rack and segment gear which are thoroughly protected from dirt and chips. The levers for operating the carriages are adjustable through a V-tooth clutch, this design permitting convenient positioning of the levers when cutting different lengths of thread. The levers may also be readily changed from one side of the carriages to the other to suit right- or left-hand operators.

The carriages are furnished with either bolt-holders or vise-grips which are easily taken off or applied. A special feature of both of these work-holding devices is that they have horizontal and vertical adjustments so that the work may be held in the proper alignment. The vise-grips are lever-operated to facilitate production, and they are separate from the sliding jaws, and quickly changed without disturbing the adjustments. Fig. 1 shows the carriages equipped with the bolt-holders. The machine is furnished at the front with a box for receiving the bolts.

BAUSH HORIZONTAL MULTIPLE-SPINDLE DRILLING MACHINES

Two- and three-way horizontal multiple-spindle drilling machines of a heavy-duty high-speed design have recently been added to the line of drilling machines built by the Baush Machine Tool Co., Springfield, Mass. These machines are designed primarily to meet the needs of the pipe and kindred industries, but they are applicable for all heavy drilling. Each head has a capacity for twenty-four 1-inch diameter drills, and the heads are built in either round or rectangular styles. Round heads range in size up to 36 inches in diameter, and rectangular heads up to 25 by 48



Baush Heavy-duty Horizontal Multiple-spindle Drilling Machine

inches. The weight of the machine illustrated is 18 tons, and it is driven by variable-speed motors of 27-horsepower capacity, which are attached directly to each head. The length of the bed is 29 feet, but smaller beds can be furnished to suit requirements.

Each head can be equipped for a fast approach and return, although the illustration shows only one head so equipped. The fast approach and return is operated electrically through a controller handle on the front of the head, which actuates a small reversible motor on the back of the head. This motor has a friction safety clutch that permits bringing the drills solidly against the work before engaging the feed, thus eliminating loss of time due to stopping the drills short of the work. There is an interlocking device that prevents engagement of the fast approach and return until after the feed-worm has been released and vice versa. The complete machine is capable of driving forty-eight 1-inch drills through cast iron at the rate of 3 inches per minute. All electrical equipment, such as controller boxes and push-button controls, are conveniently located. The patented spindle-arms allow the drilling of holes at centers practically equal to the diameter of the spindles, and there is ample spindle adjustment.

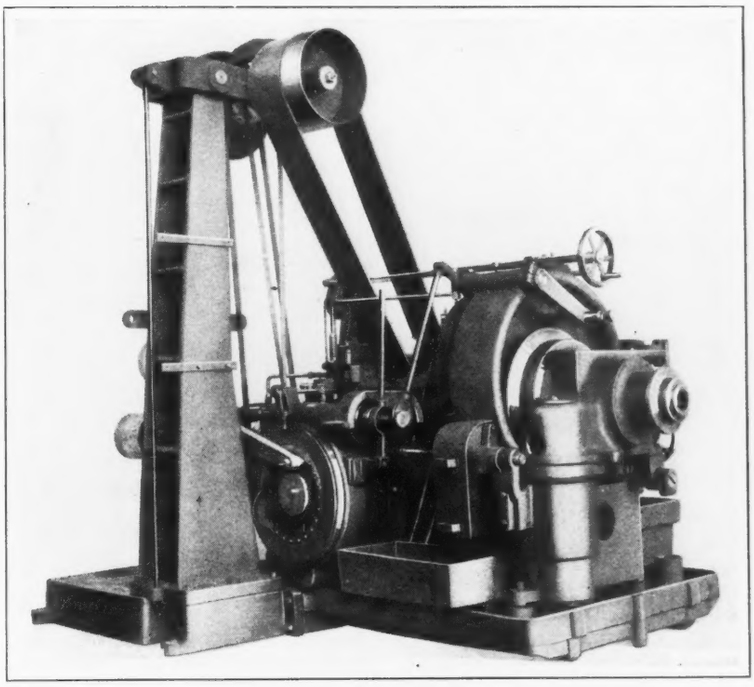


Fig. 1. Osterholm Automatic Single-spindle Rotary Surface Grinder

OSTERHOLM AUTOMATIC ROTARY GRINDER

A No. 3 Osterholm automatic rotary surface grinder of the single-spindle type has recently been developed by Williams, White & Co., Moline, Ill., for grinding large bulky castings of thin sections, such as transmission case covers, timing-gear case covers, and bell housings. The machine will accommodate work up to 24 inches in diameter and 10 inches in height. Many of the features of construction and operation are the same as in the duplex rotary grinding machine built by this company, which was described in July, 1923, MACHINERY. The machine is practically automatic with the exception of the loading and unloading. Equipped with the motor base and countershaft supporting columns, as shown in Fig. 1, the machine is self-contained. Water is supplied from the large cast-iron pan in which the machine is mounted. A pump driven by belt from the countershaft keeps the coolant always in circulation.

In Fig. 2 the work-carrying spindle is shown swung back on a vertical axis to the loading position, which is perpendicular to the axis of the grinding wheel, a timing-gear case cover being clamped in position in the work-holding fixture. After the work has been clamped, the operator swings the housing of the work-carrying spindle into the operating position, where it is locked by means of a mechanism similar to the breech-lock of large field guns. The engagement of a single lever then starts the machine on an automatic cycle, in which the work-carrying spindle is rotated, the grinding wheel fed toward the work, and the coolant automatically delivered through the hollow spindle of the grinding wheel. When the required amount of stock has been removed, the feed automatically ceases and the work-head comes to a stop. The work-carrying spindle housing is then unlocked and returned to the loading position by a single pull on the part of the operator.

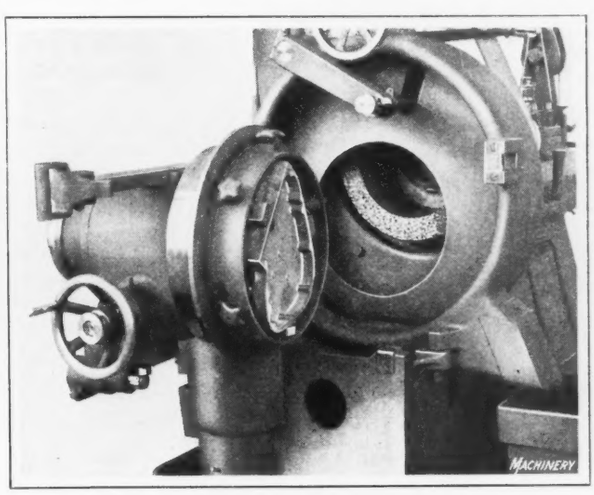


Fig. 2. Work-carrying Spindle in the Loading Position

The work-carrying spindle is equipped with thrust and annular ball bearings, and there are spring buffers to cushion this mechanism at both ends of its rotation. Steel buttons insure alignment of this spindle with the grinding wheel when the housing is locked in the operating position. Change-gears on the left-hand side of the machine furnish a means of adjusting the speed of the work-head.

The spindle head is mounted on a slide and adjusted by turning a handwheel. The outboard end of the adjusting screw is threaded into a pedestal operated by a single-tooth rack which, in turn, is actuated by a feed-cam to produce the power feed. The sector that advances the rack is located on the cross-shaft at the back of the machine, this shaft carrying a large cam-lever equipped with an intermediate cushioning spring. A roller at the long end of the cam-lever engages the feed-cam to draw the wheel back 3/16 inch during a loading, then bring it up into the working position, and finally establish a constant rate of feed through any predetermined distance to the finished position. When the finished position is reached, the roller follower rides up the advance side of the cam peak, and causes the feed lever to contact with a trip-lever, thus shifting the feed belt to a loose pulley and stopping the rotation of the work-carrying spindle. By disengaging a lever, the work-carrying spindle may continue to be rotated, while the advance of the wheel-head is stopped.

Different rates of feed may be obtained by interchanging cams; however, an adjustable spiral cam is made

for the same purpose. The contour of the feed-cam controls the depth of cut for a given operation, but the time for a cycle is determined by the ratio of the change-gears. Combinations have been adopted which permit a range of working time from ten seconds for small work to two minutes for heavier operations. In one automobile plant this machine is used in combination with a single-spindle vertical drilling machine equipped with a special fixture in which the bosses of timing-gear case covers are spotted on one part while the grinding operation is in process on another part. The spots are then used to grip the piece in the grinding step.

LINK-BELT GREASE CUP

A new top has been developed for the compression grease cup manufactured by the Link-Belt Co., of Indianapolis, Ind. This top is made hexagonal in shape to provide a good grip for both the hand and a wrench When the grease becomes cold and stiff, a compression cup is usually hard to turn, and a pipe wrench is not always available. The hexagonal shape permits gripping with an ordinary wrench in such cases. The cup is also provided with a raised slot so that it can be turned with a screw-driver when it is so located that it is inconvenient to use the hand or a wrench. The cup is known as the "Hex-Top" grease cup. It is made of malleable iron.

PRATT & WHITNEY BENCH MACHINES

A universal model of the No. 3 bench hand miller built by the Pratt & Whitney Co., Hartford, Conn., which was described in October, 1921, MACHINERY, has recently been placed on the market. Except for the size and hand feed, this universal machine is practically a counterpart of the Pratt & Whitney full-size floor machines. The column, spindle, three-step cone pulley, outboard support, and knee are the same as on the plain bench miller, but the table is of the swiveling type and can be set to any angle up to 45 degrees either way, thus having a total swing of 90 degrees. Graduations make settings of the table an easy matter, and binders provide for locking it in position. The table is equipped with a large handwheel and a ten-pitch lead-screw for traversing it. The handwheel may be geared to the dividing head.

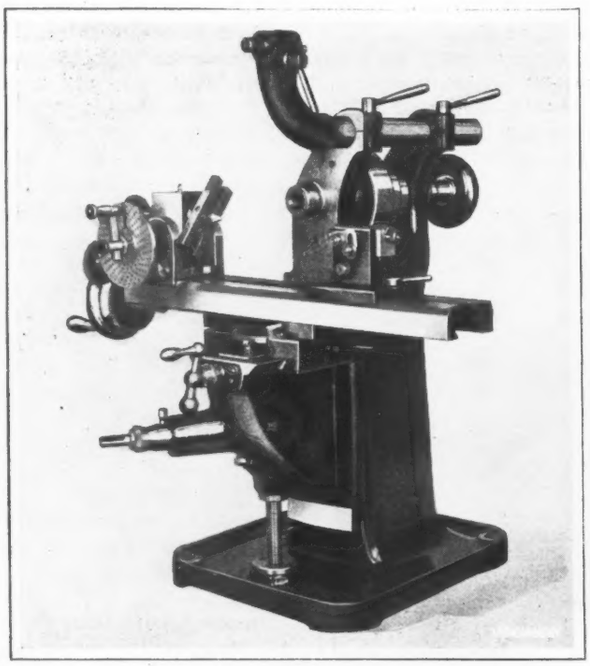


Fig. 1. Pratt & Whitney Universal Bench Miller

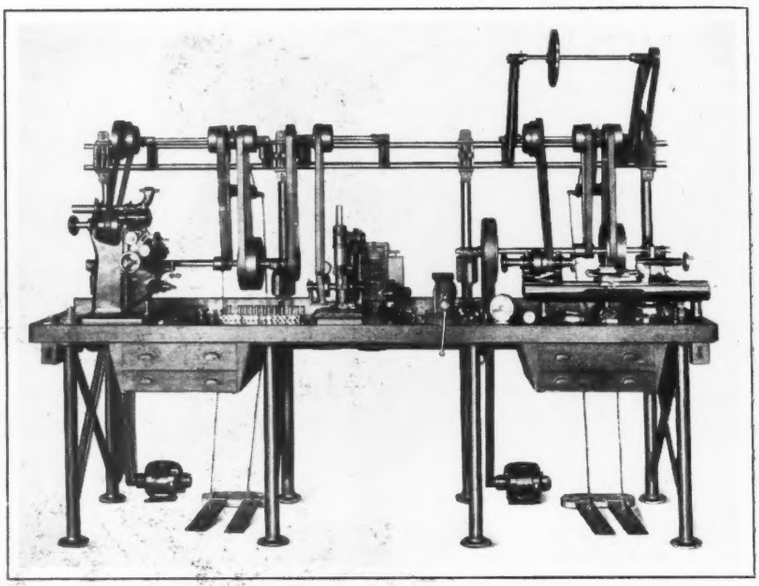


Fig. 2. Bench equipped with Miller, Drill, Lathe, Vise, etc.

The universal dividing head of the machine is mounted between trunnions, and may be swung through 135 degrees from the vertical position of the spindle to 45 degrees below the horizontal. The indexing mechanism is similar to that used in the standard heads of larger machines, and three index-plates give the same number of indexing possibilities as listed in the standard B & S tables. Owing to the small amount of clearance, it is not possible to use a fixed index-plate for rapid indexing. A set of change-gears is furnished for differential indexing and for spiral milling.

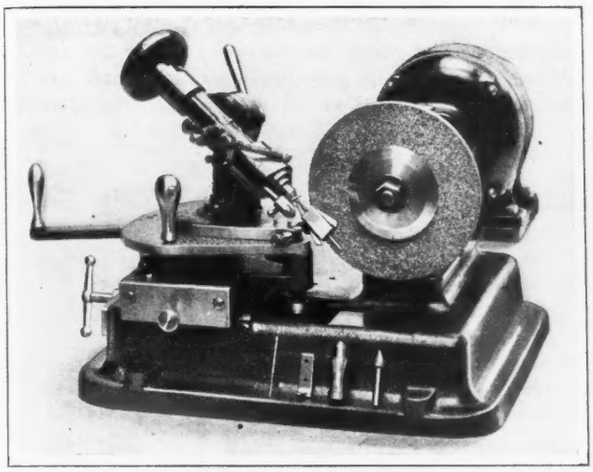
The footstock has an adjustable center that can be elevated or depressed and can be set at an angle in a vertical plane. By this arrangement the spiral-head and footstock centers may be kept in line and the footstock center set to accurately fit the center hole in an arbor or work.

A vertical milling attachment may be furnished to increase the range of work, the attachment being bolted to the face of the machine and driven from the regular spindle. A train of bevel gears drives the vertical spindle and at the same time permits swinging the spindle to any angle in a plane perpendicular to the machine spindle. An adapter may also be inserted between the attachment and the machine spindle to permit swinging the vertical spindle to any angle in a vertical plane parallel to the main spindle. The weight of this bench machine is about 185 pounds.

Fig. 2 shows a complete set of bench machinery which is also being brought out by the Pratt & Whitney Co. The equipment consists of the No. 3 universal bench miller just described, the P. & W. No. 3 bench lathe, a No. 0 Sigourney bench drill, a hand vise, and the various attachments of the machines. The equipment is mounted on a standard bench furnished with drawers for holding various parts. The drive is from two ½-horsepower motors, so arranged that either unit of the machine may be operated independently of the other. The bench lathe is equipped with a compound rest, grinding, milling, and filing attachments, drill pads, faceplates, chucks, and collets. The lathe and milling machine are controlled by foot-pedals which give each machine two speeds, and the drill is equipped with a belt-shifter.

NOYES DRILL-POINTING MACHINE

Small drills from No. 60 to ¼ inch can be sharpened on the Noyes drill-pointing machine, which has recently been placed on the market by the Connecticut Cutter & Machine



Noyes Drill Sharpening Machine for Small Sizes

Works, Inc., 50 Reamer St., Bridgeport, Conn. The edge of the grinding wheel is used for sharpening, there being an adjustment whereby the angle of clearance may be readily changed to suit the diameter of the drill. The necessary cross-adjustment is made by turning the knurled-head screw seen just below the point of the drill. This screw is provided with graduation marks to suit different sizes of drills.

The drill is held in a spindle which is fitted to a headstock arranged to swing in a vertical arc. The headstock, in turn, is clamped to a bracket which carries the cross-adjustment members. There is also a slight horizontal adjustment for the headstock, which is utilized by turning the knurled-head screw located just below the draw-in collet handle. The collet is of a special design that supports the drill close to the point, and it is furnished in 1/64-inch sizes, from ⅛ to ¼ inch. Split bushings that may be quickly changed are provided for holding drills under ⅛ inch in diameter.

In order to locate the drill point accurately and quickly when placing it in the collet, a gage has been designed in which the point of the drill is inserted against an adjustable stop, as shown in the illustration. There are reference marks on this stop to correspond with the various drill sizes. With the drill point inserted in the gage, the drill is pushed into the collet until the jaws of the latter meet those of the gage. With the smaller sized drills, the bushing is slipped on the drill against the gage, and then both the drill and bushing are pushed into the collet until a shoulder on the bushing registers against the jaws of the collet.

Another feature of the machine is a special indexing device which provides for varying the spacing of the drill lips or flutes. The device consists of a pointer or finger which is fitted adjustably to a rock-shaft pivoted in the headstock. On one end of the rock-shaft is an arm equipped with an adjusting screw which rests on the neck of the headstock in such a way that the finger may be engaged with the drill flutes without resting on the flutes. Longitudinal adjustment of the rock-shaft is provided so that the finger may support the drill close to the point. To permit changing drills without interference, the finger may be thrown out of engagement as illustrated.

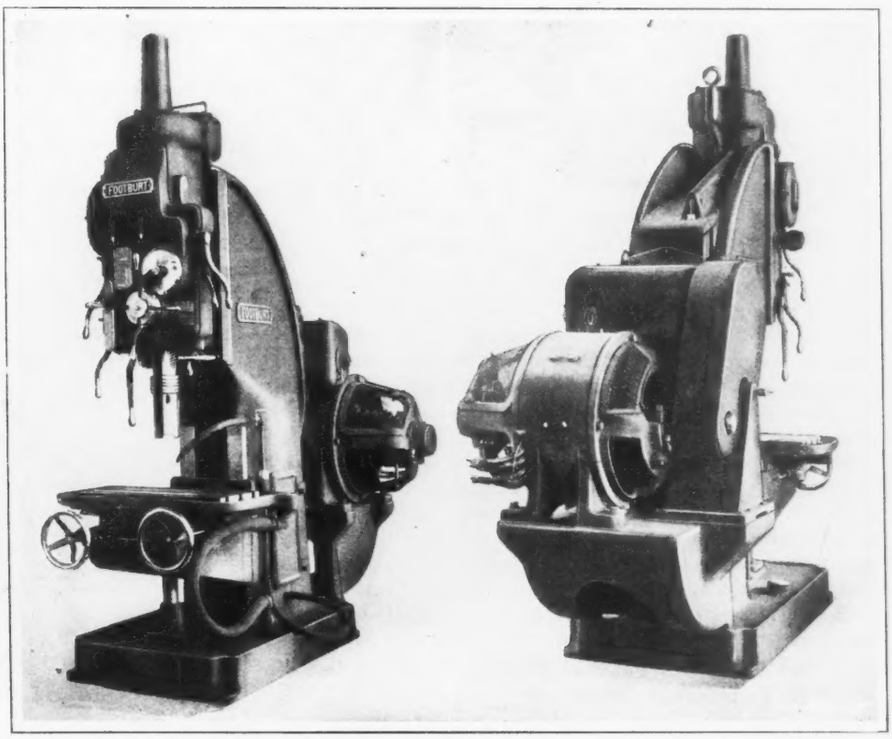
There is a locking pin in the headstock which furnishes a means of holding the spindle in clamping the drill. After this pin is released, the spindle is turned by means of the draw-in wheel until a lip of the drill is so located by the finger that its cutting edge is in a vertical position. The drill is then moved into the grinding location, and after one lip has been touched up by swinging the swivel table, the swing is slightly increased to move the drill point sufficiently away from the wheel so that there is enough clearance for indexing to the next lip. A diamond truing device is furnished.

FOOTE-BURT HIGH-DUTY DRILLING MACHINE

Much interest was shown at the recent convention of the American Railway Association held at Atlantic City, N. J., in the new No. 25½ heavy-type, high-duty drilling machine exhibited by the Foote-Burt Co., Cleveland, Ohio. Equipped with a Cleveland 1¼-inch drill, the machine was able to drill through cast iron at the rate of 116 feet per minute, which is believed to be the world's record. The machine has a rated drilling capacity of 5 inches through solid steel.

With a view to obtaining maximum rigidity, the head is bolted to the face of the upright in such a way that the bolts are subjected to shear instead of being in tension. In combination with the heavy upright and head, this construction is said to prevent deflection at the point of the drill. Another feature that is particularly advantageous when machines are grouped close together is that the head unit can be completely detached from the upright for repairs. The entire mechanism of the machine is contained in the head proper, and consequently the removal of the head for repairs does not disturb other parts of the machine. The head may be readily removed by the use of a crane.

Attention is called particularly to the double helical feed-rack drive for the spindle, which may be seen in the illustration. The speed changes are obtained through a sliding gear arrangement similar to that used in automobile transmissions. Nine speed and nine feed changes are available by simply manipulating levers, and by transposing a set of

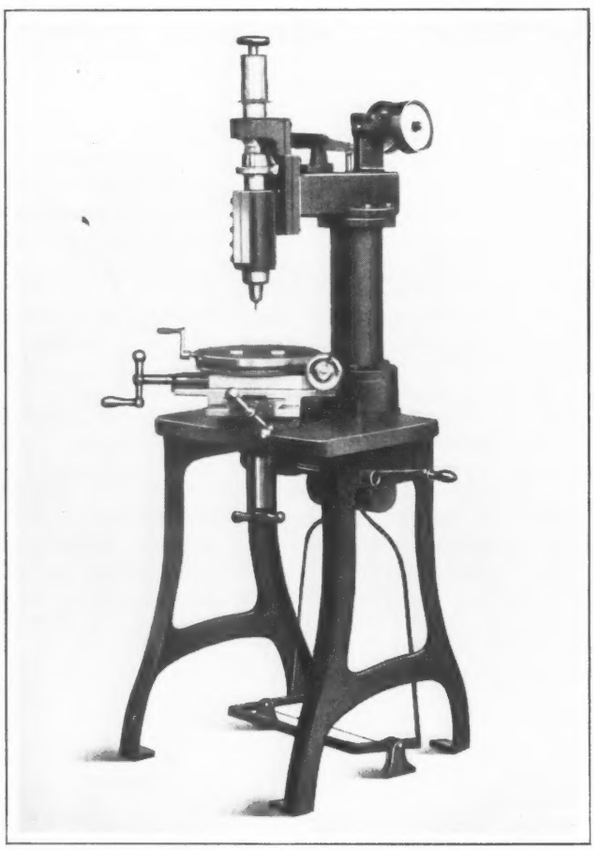


Foote-Burt Heavy-type High-duty Drilling Machine

pick-off gears, a total of eighteen feeds ranging from 0.006 to 0.140 inch per revolution can be obtained. The speeds range from 25 to 201 revolutions per minute. The machine can, of course, be furnished for either a belt or motor drive. Some of the principal specifications are as follows: Maximum distance from nose of spindle to top of plain table, 35 inches, and to top of compound table, 30 inches; distance from center of spindle to face of column, 18 inches; length of power feed, 16 inches; vertical adjustment of table, 18 inches; weight of machine with plain table about 10,000 pounds; with compound table, approximately 11,000 pounds.

STARK ROUTING MACHINE

A machine adapted for use in diemaking and other operations where a high-speed vertical milling machine is required has recently been developed by the Stark Tool Co., Waltham, Mass. It is equipped with a high-speed sensitive spindle capable of producing intricate work in combination with a suitable tool. The spindle head is counterbalanced and raised or lowered instantly by means of the foot-treadle, the depth of cut being controlled by an adjustable stop-screw at the front of the spindle head. All parts are said to be so balanced that it is possible to run the spindle at any speed up to 9000 revolutions per minute without objectionable vibration.

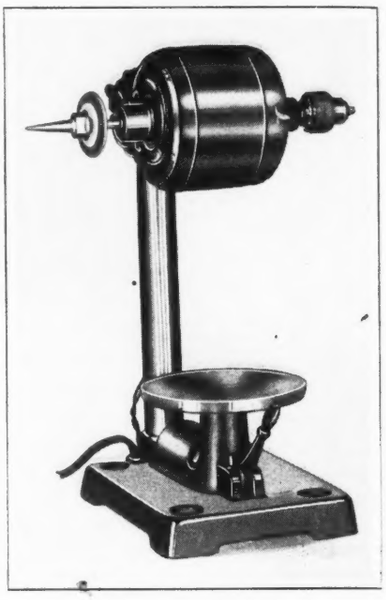


Stark High-speed Sensitive Routing Machine

The table feed-screws advance the table ⅛ inch per turn and engage bronze nuts which automatically compensate for wear. This is an important feature, as it allows the user to operate the slides for the full length without backlash or binding, even though the screw is worn at the centers and not at the ends. A 10-inch rotary table fitted with vise jaws is mounted on the table slides for holding the work. It is operated by a worm around a complete circle and may be clamped in position at any point. It may also be raised or lowered to suit work of different thicknesses. The vertical adjustment of the spindle is 1¼ inches and of the table, 3¾ inches; and maximum distance from end of spindle to top of table, 5 inches.

FIDELITY COMBINATION MACHINE

A combination bench machine which may be used for drilling, grinding, and polishing operations, and which is universal in that it may be driven by both alternating and direct current of 110 volts, has just been placed on the market by the Fidelity Electric Co., Lancaster, Pa. The motor is held on the vertical post by means of a bracket which is provided with two bearings located at right angles to each other. These two bearings permit of mounting the motor horizontally as shown, for grinding and polishing operations, and vertically for drilling operations. The motor can be conveniently attached in any position on the post. The motor is equipped with a ball thrust bearing and wick-feed oil-cups. The equipment will drill holes up to ⅛ inch in diameter.

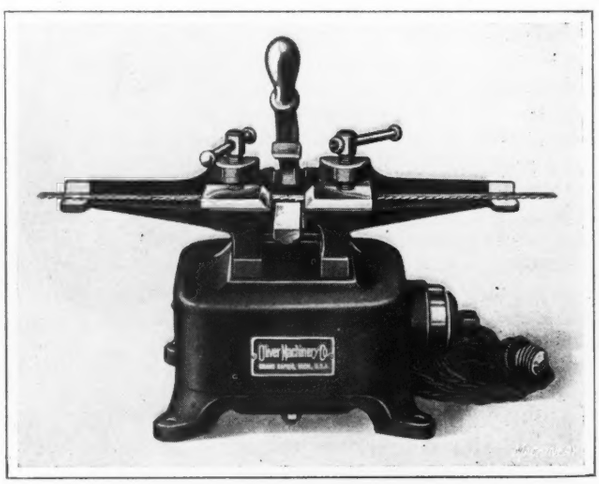


Fidelity Combination Drill, Grinder, and Polisher

OLIVER BAND-SAW BLADE BRAZER

Band-saw blades of No. 19 gage or thinner, and up to 1½ inches wide, may be brazed electrically by means of the "Vulcan" brazing machine here illustrated, which constitutes the latest addition to the line of machines built by the Oliver Machinery Co., Grand Rapids, Mich. The device utilizes the electric heat of resistances for melting down the soldering metal, and it may receive current from either a 110- or 220-volt circuit. The current consumption is small.

The equipment comprises a transformer of which the main coil is connected to the power or light circuit through a switch, and a secondary coil which serves as a stay for both saw ends. In an operation, the saw ends to be brazed are beveled by filing them off to about the width of the saw blade, and then overlapped about ½ inch. A strip of silver solder is next laid between them and the operation started by turning the switch. After some seconds, the brazed seam will glow and melt the brazing metal. The switch can be



Oliver Electric Band-saw Blade Brazer

regulated both backward and forward to permit controlling the heat conduction during the melting period. After this, the brazing metal is distributed on both sides by means of a borax flux so as to obtain a tight connection and a clean brazed seam without scale. If the braze is too hard or too soft, the condition can be easily remedied.

Lowe Indicator graduated to 0.0001 Inch

LOWE INDICATOR

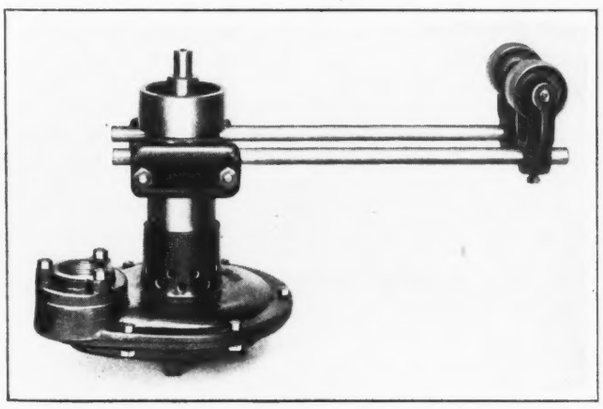
A model D-10 indicator has been added to the line of "Last Word" indicators manufactured by H. A. Lowe, 1874 E. 66th St., Cleveland, Ohio. This indicator is graduated to 0.0001 inch, and has a magnification ratio of 300 to 1. It is furnished with a surface gage attachment and a gooseneck shank, the latter adapting it for use in lathe, shaper, grinder, or milling machine operations. The dial is adjustable, and the lever is of a plain design.

"GUSHER" LUBRICANT PUMP

A machine tool lubricant pump known as the "Gusher" has recently been developed by the Ruthman Machinery Co., N. W. cor. Front and Pike Sts., Cincinnati, Ohio. This pump is made in two sizes, the model BL being provided with a 1½-inch diameter connection for delivering 50 gallons of lubricant per minute when running at 800 revolutions per minute, and the model FL having a 1¼-inch diameter connection for delivering 30 gallons per minute when running at the same speed. The larger size weighs 24 pounds, and the smaller, 12 pounds.

The pump is shown arranged for belt drive in the accompanying illustration, it being convenient to drive the belt either from a countershaft or from a pulley on the machine. Provision is made for adjusting the belt in any direction and for regulating the tension as required. Another convenient arrangement for driving the pump is by transmitting power from the main driving shaft of the machine through spiral gears. The rate of flow may be easily controlled to suit operating conditions by simply changing the speed of rotation of the pump. The delivery of lubricant up to the full rated capacity is said to start as soon as the pump is put into action.

It is claimed that the pump cannot be damaged by any chips or dirt that may pass through the strainer. Another feature of the design is that the impeller shaft runs in ball bearings which are thoroughly protected against damage from the solution pumped.

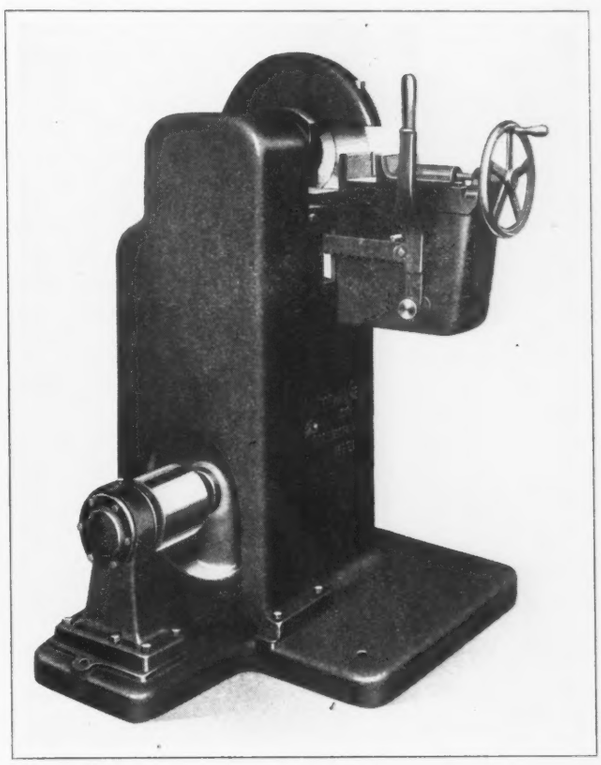


"Gusher" Lubricant Pump brought out primarily for Machine Tools

COCHRANE-BLY CUTTING-OFF MACHINE

A cutting-off machine recently placed on the market by the Cochrane-Bly Co., Rochester, N. Y., is shown in the accompanying illustration. The machine is of a heavy design, and all shafts and spindles are mounted in Timken roller bearings contained in dustproof cases. The machine will accommodate an abrasive cut-off disk, a toothed saw, or a friction disk with a maximum diameter of 16 inches. The abrasive wheel is used for cutting hardened drill rod, unannealed tool bits, magnet steel, monel metal, and various other metals, both hard and soft; the toothed blade, for copper and brass wire, rod, tubing, aluminum, rolled-steel moldings, etc.; and the friction disk, for rolled sections such as angle- and channel-irons and steel wire, rods, tubing and other sections.

The adjustable vise will hold parts up to 4 inches in diameter. The spindle speeds should vary for the different



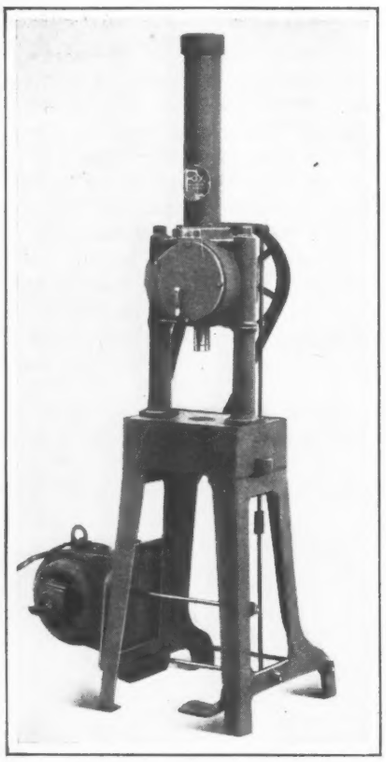
Cochrane-Bly Cutting-off Machine designed for cutting Various Materials

wheels and materials, from 2500 to 6500 revolutions per minute. The pulleys have solid webs and are turned all over and balanced. The machine can be furnished with a belt or motor drive. It requires either a 5- or a 7½-horsepower motor, depending upon the operating speed.

FOX "SUPERFLEX" PRESS

The latest addition to the line of presses built by the Fox Machine Co., Jackson, Mich., is the 3-ton "Superflex" press here illustrated. This machine may also be furnished without legs, in which case the bedplate is bolted to a bench. The press may be driven by a motor or from a countershaft.

In the operation of this machine, a yielding pressure is obtained by transmitting the power through a system of planetary gearing in which the gears, brake-band and brake-drum revolve in a chamber partially filled with lubricant. The arrangement results in the thorough lubrication of all bearings and the brake-band, and permits holding the brake-drum under a yielding pressure so as to obtain the desired force for pressing bushings into place, straightening, broaching, and other operations. The ram has an



Fox "Superflex" Press

advance travel of 150 inches per minute, and a return speed of 300 inches per minute.

Spur gears are used throughout for driving, the principal ones being made of chrome-nickel steel and heat-treated, as is also the ram. Oil gages indicate the amount of oil to be carried in the drum chamber. There are adjustments for keeping the brake-band under the proper tension. A two-horsepower motor running at 1200 revolutions per minute is recommended for driving. Some of the principal specifications are as follows: Maximum ram stroke, 10 inches; distance between uprights, 9½ inches; dimensions of top of bed, 12 by 16 inches; and weight of press equipped with legs and motor base, about 645 pounds.

BUFFALO IMPROVED DRILLS

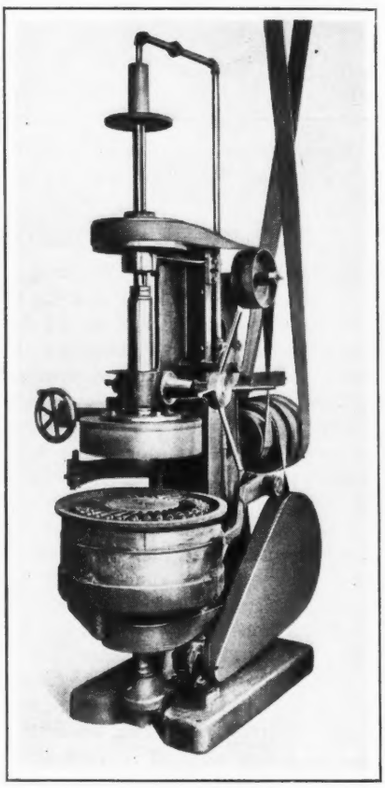
A new motor drive has been brought out for the 10-inch "Junior" bench drilling machine manufactured by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y., which was described in MACHINERY several years ago. In the older design, a gear and pinion were employed between the motor and the lower cone pulley, which resulted in noisy operation. To eliminate this, the lower pulley is now keyed direct on the motor shaft as illustrated. The motor is of ¼ horsepower capacity, and runs at 1750 revolutions per minute. Two speeds are obtainable for the spindle of this machine. The spindle runs in a large bronze bearing and is provided with a No. 2-A Jacobs chuck.

Buffalo Improved Bench Drilling Machine

An improved method of engaging two gears of the capstan-head drilling machines made by the same company, is also announced. In the older design of this equipment, a collar was moved by hand to engage either of the two gears. To make the engagement more convenient and quicker, a sleeve is now placed behind the chuck and a fulcrum lever has been added. The sleeve contains a groove in which a yoke operates. Either gear is now engaged by simply manipulating the lever.

"MIRRA" LAPPING MACHINE

Automobile piston-pins of all standard makes and other similar parts of cylindrical shape can be lapped by a new process on a machine being introduced to the trade by the Reed-Prentice Co., Worcester, Mass. In this lapping machine, which is known as the "Mirra," a number of piston-pins are placed loosely in a quick-loading spider located between two lapping wheels. These wheels rotate on vertical axes in opposite directions and at slightly different speeds. The illustration shows the spider loaded with the piston-pins resting on the lower wheel and the upper wheel raised.



"Mirra" Lapping Machine for Piston-pins and Similar Work

In operation, the upper wheel is brought down on the pins under pressure, and the variation in wheel speeds causes the pins to rotate between the wheels and creep slowly in a circular path. The projecting arms of the spider are not radial with the center, and this construction causes the piston-pins to have a sliding action between the wheels in combination with the rotation. Also, the center of the spider rotates on an eccentric, which gives an in and out sliding action of the piston-pins relative to the center of the wheel. Thus there are three movements of the pins—first the creeping in a circular path, second the sliding-rotating action, and third, the in and out sliding action.

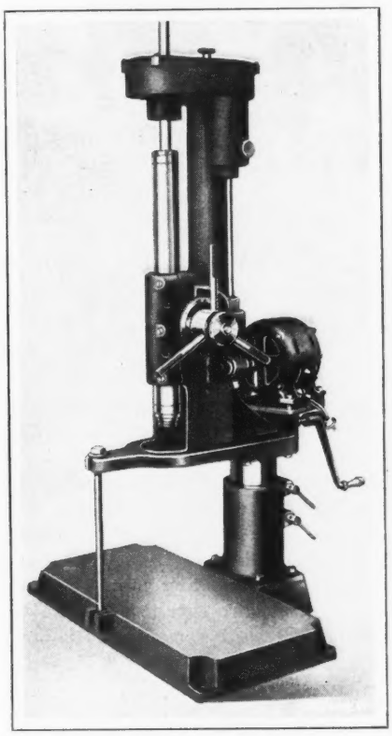
The use of both rough- and finish-lapping operations results in the production of highly polished surfaces, free from grooves. The rough-lapping is performed by using a fine grinding wheel, and the finish-lapping by a soft elastic wheel. It is said that the roundness of work is easily kept within 0.0001 inch, the taper variation in length within 0.0001 inch, and the diameter within plus or minus 0.0001 inch.

The two wheels are independently driven from a pulley shaft at the rear of the machine. They are located in separate heads mounted on a heavy column. The vertical movement of the upper wheel-spindle is controlled from a pilot handwheel on the side of the machine. There is no vertical adjustment for the lower head. The end thrust of both wheels is taken by ball bearings.

A double-end diamond wheel dresser is located on the left-hand side of the machine and operated through a hand-wheel. Both wheels can be dressed independently by means of the same mechanism. A pump furnishes a constant flow of lubricant to the work, a special compound being used to prevent rust. When the upper wheel is lowered on the work, a circular guard is automatically raised to surround the work and the wheels and prevent the compound from flying about.

CINCINNATI "BORHONIZING" MACHINE

A portable machine for reboring and honing automobile cylinders is now being manufactured by the John Steptoe Co., 2961 Coleraine Ave., Cincinnati, Ohio. This machine is known as the "Cincinnati Borhonizing" machine. It is driven by a ½-horsepower motor which runs at 1700 revolutions per minute and receives current from a light socket.



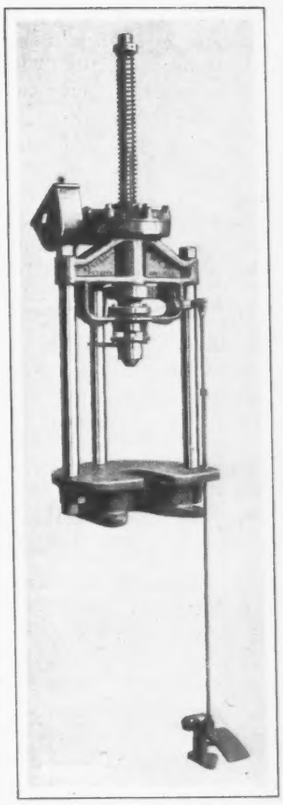
Cincinnati "Borhonizing" Machine

Cylinders from 2⅝ to 6 inches in diameter may be refinished to a depth of 15 inches. In addition to automobile cylinders of all sizes and styles, motorcycle, truck, and other gas engines can be handled. The boring head is a self-centering design with inserted cutters, and the hones are also inserted in a separate head. The spindle sleeve is operated through worm-gearing and a rack and pinion. The boring and honing heads are screwed on threads at the lower end of the spindle which are eight to the inch so that the heads may be put on and removed quickly. At the lower end of the column casting is a bracket which clamps the cylinders in alignment with the spindle.

Three spindle speeds may be obtained while the machine is in operation by simply moving a knob at the top of the column casting, while two spindle feeds are secured by means of a knob on the side of the casting near the top. The main drive shaft is driven direct from the motor through worm-gearing. The time required for reboring and honing cylinder blocks is said to be 1 hour for a four-cylinder block, 1½ hours for a six-cylinder block, and 2 hours for an eight-cylinder block.

FLEXIBLE-POWER ARBOR PRESS

A three-ton power-driven arbor press of the bench type, which has just been placed on the market by the General Manufacturing Co., 6442 Farnsworth Ave., Detroit, Mich., is shown in the accompanying illustration. The machine may be furnished on a column or with a bracket for mounting on the bed of a lathe. It may be arranged for a belt drive, as shown, or equipped with a silent chain drive and a motor bracket. The machine is controlled entirely by a foot-pedal, by which means it is possible to vary the pressure at will from a few pounds to at least three tons. It may be used for straightening parts, pressing in bushings, and the usual range of arbor press work.



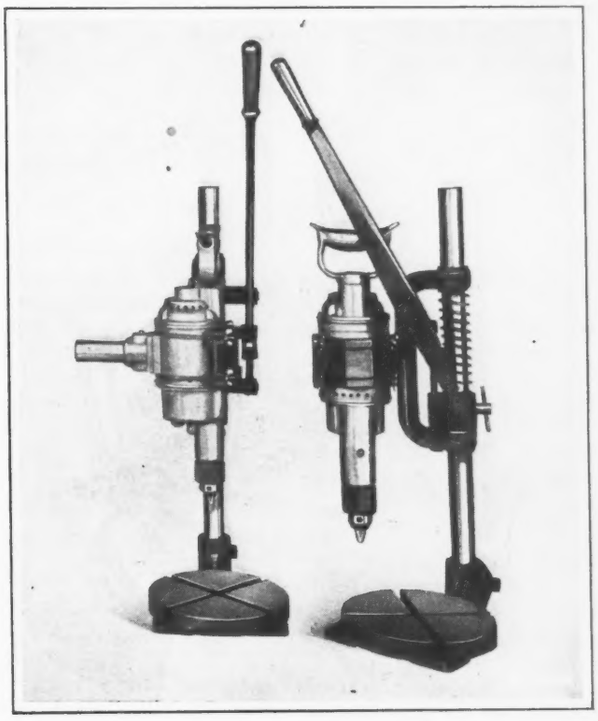
Flexible-power Arbor Press

The ram is driven at a constant speed in one direction by worm-gearing and spline keys. A ram nut, which is also the brake-drum, revolves with the ram until pressure is applied to the foot-pedal to stop the nut. The ram then screws down through the nut until the foot-pedal is released or the brake band slips at a pressure depending on the pressure applied on the foot-pedal. When the pedal is released, the ram and the nut are returned by a compression coil spring. At the upper end of the return stroke a brake stops the nut without shock.

The ram has a six-start Acme thread. Its anvil is prevented from turning by a torque lever which slides on the third or back post. The thrust of the nut is taken on a ball bearing. This machine accommodates work up to 14 inches in diameter between the posts, has an opening of 12 inches between the table and the lower end of the ram, and a ram stroke of 6 inches. However, the opening and stroke length can be made special to other dimensions. The weight of the equipment is about 400 pounds.

NEIL & SMITH DRILL STAND

An "Ideal" bench drill stand accommodating four sizes of drills has just been brought out by the Neil & Smith Electric Tool Co., 905 Broadway, Cincinnati, Ohio, for use with the drills of this company's manufacture. The drills



Neil & Smith Bench Drill Stand

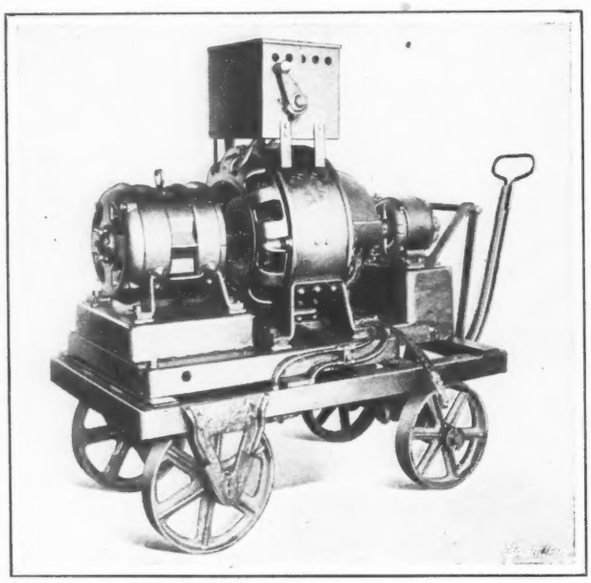
accommodated have a capacity for drilling holes ranging from ¼ to ½ inch. Separate adapters are not required for attaching the drills to the stand; they are simply clamped to the stand without removing any parts from them or making other changes.

The bracket that supports the drill is of V-form, and in combination with two flat spring clamps, tightened by means of thumb-screws, holds the drill rigidly. The bracket can be raised, lowered, or swung to any point on the column and clamped in position. An adjustable depth gage on the bracket guide rod enables an operator to drill to a predetermined depth. By providing a longer column and two holding brackets, a post drill stand is obtained. The vertical feed of the drill is 4 inches, and the drilling radius, 5 inches. On the bench stand the vertical adjustment of the drill is 11 inches, and the weight of the stand, 30 pounds.

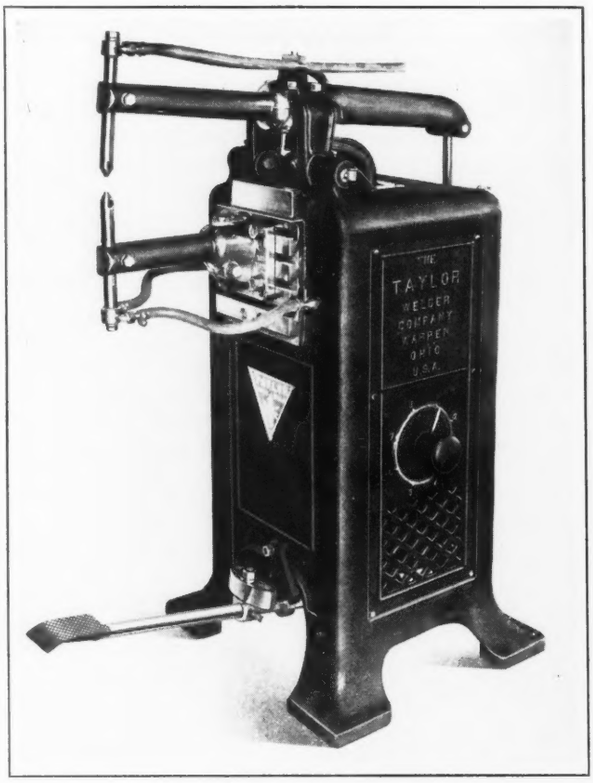
WESTINGHOUSE ARC-WELDING EQUIPMENT

A self-contained single-operated 200-ampere arc-welding apparatus has recently been developed by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., which is available in stationary and portable styles. The generator will deliver 300-ampere current on intermittent work. There are sixty-one rheostat resistance steps which enable the operator to obtain a close current control from 60 to 300 amperes by simply operating the rheostat handle on the control cabinet mounted on top of the generator. If an unusually high current is desired, the generators of several machines may be operated in parallel. The generator stabilizes the arc and thereby overcomes any resistance fluctuations in the arc circuit. Any commercial size of metallic electrode from 1/16 to 1/4 inch in diameter may be used.

The generator and motor have a common shaft to which the exciter is coupled by means of a flexible coupling. Either an alternating- or direct-current motor is furnished. Alternating-current motors may be used on 220- and 440-volt circuits by simply rearranging the lead connections. Motors of that style are started by connecting directly to the line through a safety switch, whereas the direct-current motors are put into operation by means of a starting rheostat. An ammeter and voltmeter may be mounted on the cabinet for observation by the operator as he adjusts the rheostat. The unit is constructed with a view to having it withstand severe service in railroad shops and other places where welding equipment generally receives rough usage.



Westinghouse Arc-welding Equipment



Taylor Spot-welding Machine

TAYLOR SPOT-WELDER

One of a new line of spot-welding machines being introduced to the trade by the Taylor Welder Co., Warren, Ohio, is shown in the accompanying illustration. This new type N machine is built in three sizes for welding work ranging from No. 30 gage material to two plates 3/16 inch thick. The overhang is from 6 to 30 inches. The upper horn is adjustable in and out to permit the use of gooseneck welding points with one of the regular welding points, and both horns can be revolved in either direction to allow welding in corners and otherwise inaccessible places. The lower horn is adjustable up and down and sidewise in either direction.

The smallest machine is equipped with a 10-kilowatt transformer, the intermediate with a 15-kilowatt transformer, and the largest with a 20-kilowatt transformer. There is an eight-step self-contained regulator for adjusting the current to take care of the lightest work up to the capacity of the machine. The switch is of an automatic and non-automatic type so designed that it cannot close until the electrodes have made proper contact with the work. No adjustment is required for different thicknesses of work or for wear of the electrodes. The switch is changed from an automatic to a non-automatic trip by simply operating a lever. The automatic trip is desirable for welding work that is buckled and does not fit together properly, as it permits a positive pressure to be applied to the weld after the current has been turned off, and thus prevents the weld from separating while in the molten state. It is desirable to set the switch in the non-trip position in welding wire and clean sheets, and also in operations where greater speed is wanted. The pressure on the electrodes is controlled by means of a handwheel. In addition to the water circulation in the electrodes, the transformer is water-cooled. The machine may be furnished with a quick-change gear-box and either a belt or motor drive. The foot-treadle is adjustable in or out and may also be swiveled to suit the convenience of the operator. The travel of the upper electrode and the foot-treadle can be varied for different thicknesses of work by means of a lever which is located on the front of the machine.

LEHMANN IMPROVED LATHE SPINDLE

An improved hardened spindle with a patented nose has recently been developed by the Lehmann Machine Co., 3569 Chouteau Ave., St. Louis, Mo., for use on all the geared-head lathes built by this company. The spindle is made of alloy steel and heat-treated to different degrees of hardness. The spindle runs in bronze bearings, and drives through four integral keys. The patented nose has a hardened bearing for the chuck or faceplate on both sides of the thread, which is said to give a maximum torque value. The threads are a little flat on the inside diameter of the plates, and there is a free fit over the outer nose which permits the members to be slipped over the nose and piloted on the threads. Several threads are engaged before mating portions come into contact, a construction which is said to permit close fits.

* * *

THREAD AND PIPE STANDARDS

According to an announcement of the American Engineering Standards Committee, an American national screw thread for fire-hose couplings has been definitely approved. The approval of this standard, which has been adopted jointly under the leadership of the National Board of Fire Underwriters, the National Fire Protection Association, the American Society of Mechanical Engineers, and the American Water Works Association, marks for the first time, a national agreement on tolerances and limits of accuracy necessary to secure interchangeability. The lack of such an agreement as to tolerances has been an important cause of non-interchangeability in fire-hose couplings in use in American cities and towns, even where threads in accordance with the national standard of hose threads were supposed to be in use.

At a conference recently held in New York City under the auspices of the American Engineering Standards Committee, it was decided to undertake the standardization of cast-iron pipes. The kinds of cast-iron pipe that will be considered include flanged pipe, pipe elbows, tees, return bends, and other fittings not now included in standard lists, cast-iron pipe threaded for flanges or couplings, and soil pipe and other light types of cast-iron pipe and fittings.

GEARS OF UNUSUAL SIZE

In the machine-building field there is an ever-increasing need for larger and more powerful machines that will handle work of greater size and weight than has been accommodated in the past by machines of the same type. Larger machines naturally require larger individual parts. Fig. 1 shows a bevel gear of massive proportions which was recently made by the Poole Engineering & Machine Co., Baltimore, Md. It has a pitch diameter of about 11 feet, and 84 teeth of 4.9-inch circular pitch; the face width is 19 inches. When finished, it weighed approximately 10 tons.

The gear was made by the Poole machine-molding method from a charcoal gun-iron mixture. It will be seen that the gear was cast in two sections, with the teeth "housed" on both ends. The joints were planed and junction plates assembled at these points. This gear is used in driving a grinding and polishing table for making plate glass.

Another unusual gear recently made by the same concern is the worm-ring shown in Fig. 2. The size of the man gives an idea of the large diameter of the ring. This gear is nearly 17 feet in diameter, has 422 teeth of 1½-inch circular pitch, and a face width of 2¼ inches. It weighs about 4400 pounds. The worm has a single right-hand thread and seems quite small in comparison with the gear. This ring was also cast in two sections, which are bolted together.

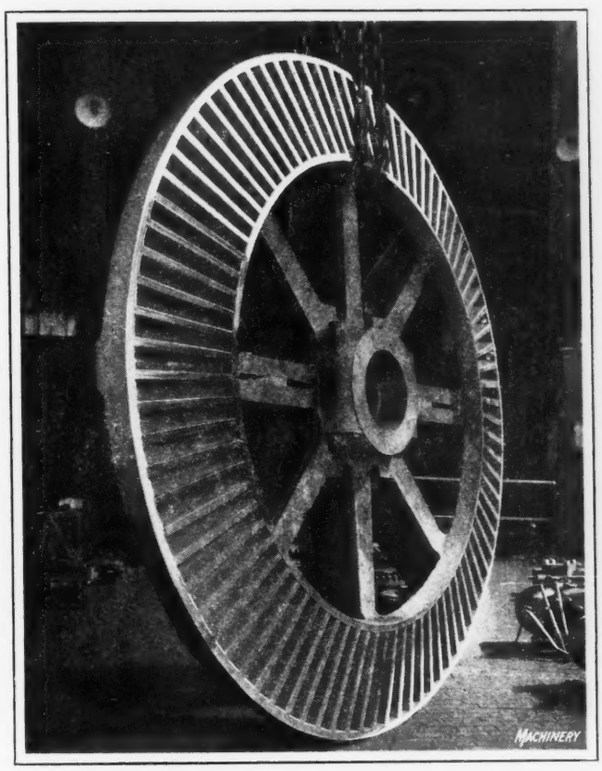


Fig. 1. Bevel Gear weighing about Ten Tons

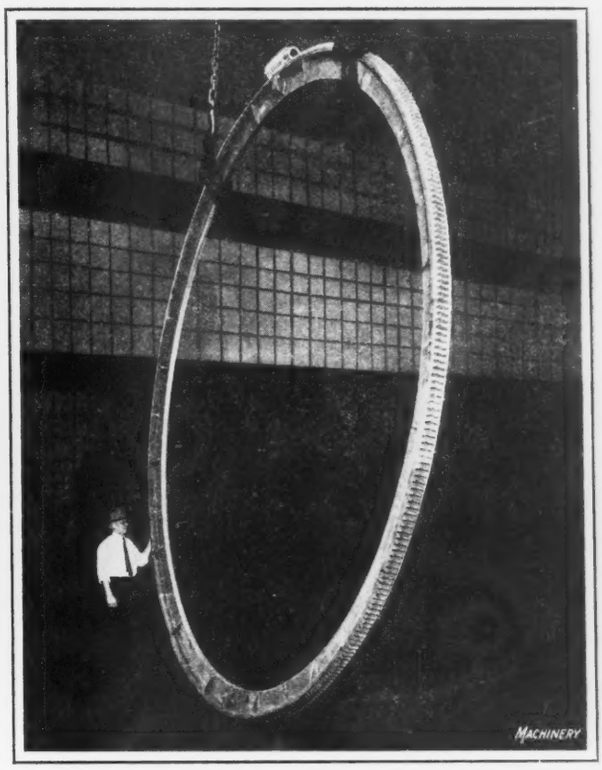
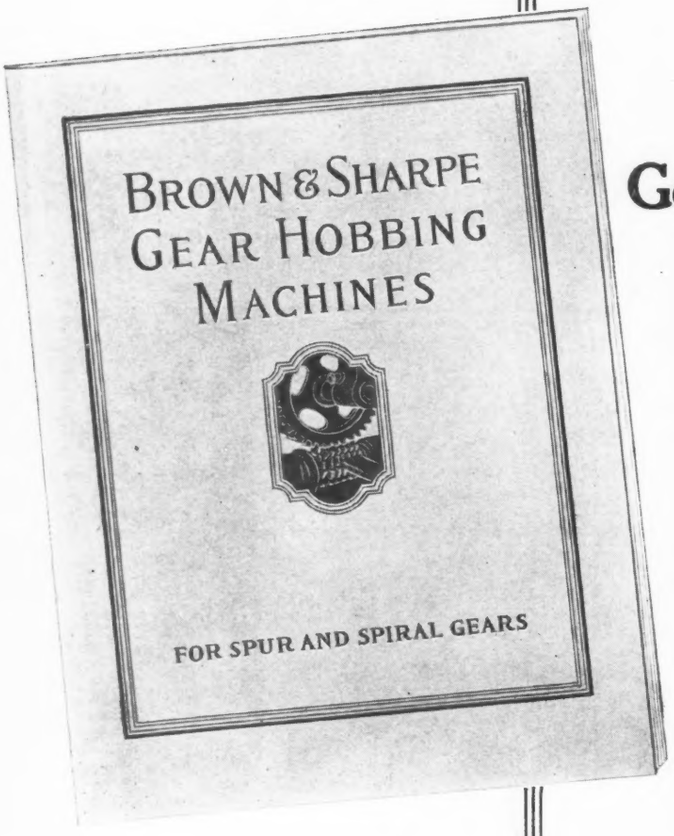


Fig. 2. Worm-ring almost Seventeen Feet in Diameter

* * *

The inauguration of the transcontinental air mail service from New York to San Francisco, with stops at intermediate points, is a definite milestone in the development of aerial navigation. Twenty years ago, the most optimistic would not have believed that regular aerial postal service between New York and San Francisco could be maintained a comparatively few years after flying was in the experimental stage. This air service between New York and San Francisco will require about 33 hours, as against 96 to 120 hours by train. The transcontinental air mail service is divided into three zones, New York to Chicago, Chicago to Cheyenne, Wyo., and Cheyenne to San Francisco. The rate of postage will be 8 cents an ounce or fraction thereof for each zone or part of a zone in which the mail is carried by airplane.

For Better Gears



Two New
BROWN & SHARPE Gear Hobbing Machines

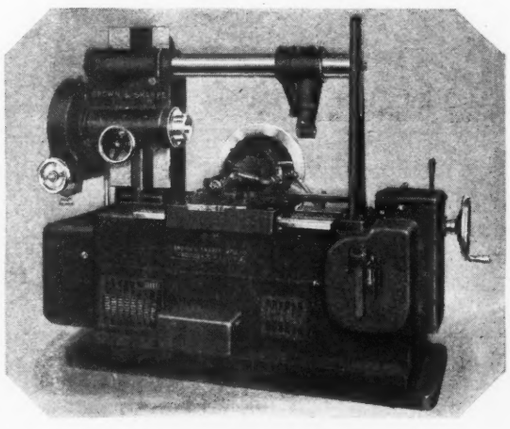
To produce high quality silent running gears in large quantities, Brown & Sharpe have developed two Gear Hobbing Machines—the No. 34 for spur gears only and the No. 44 for spur and spiral gears.

In their design everything has been done to make them easy to operate and due to their rugged construction they will cut gears at a rapid rate without sacrificing accuracy.

Brown & Sharpe Gear Hobbing Machines will meet the most exactly requirements of modern gear users. Especially are they adapted to automotive work where they are used to cut, accurately and quickly, transmission and timing gears in large quantities.

B·S
TRADE MARK

We have prepared a booklet telling the many points of advantage you can secure by using Brown & Sharpe Gear Hobbing Machines. If you are interested in better gears and more of them write for a copy today.



BROWN & SHARPE MFG. CO.

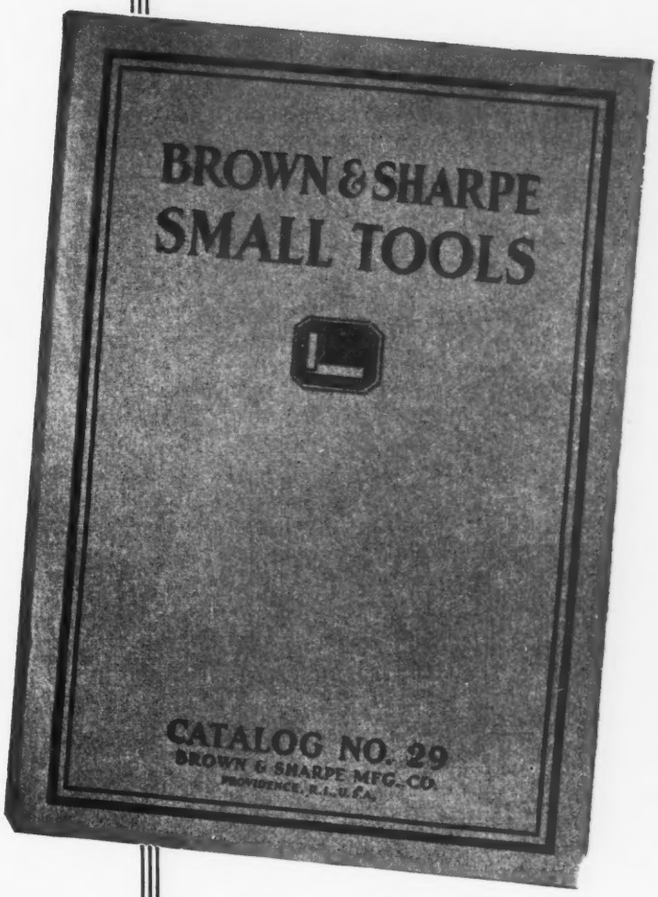
For Better Tools

The New BROWN & SHARPE Small Tool Catalog

This new Catalog lists many new and improved tools that are important to every man interested in mechanical work. Over 2000 different styles and sizes of tools are listed. In addition to being illustrated it contains much information concerning tools, tables, etc., making it a handy reference book that no mechanic can afford to be without.

The quality of your work cannot be any higher than the quality of the tools used to check it. Every tool listed in the New Brown & Sharpe Small Tool Catalog is made with an accuracy for which the name Brown & Sharpe is known the world over.

Ask your dealer for a copy. If he cannot supply you, write us direct.



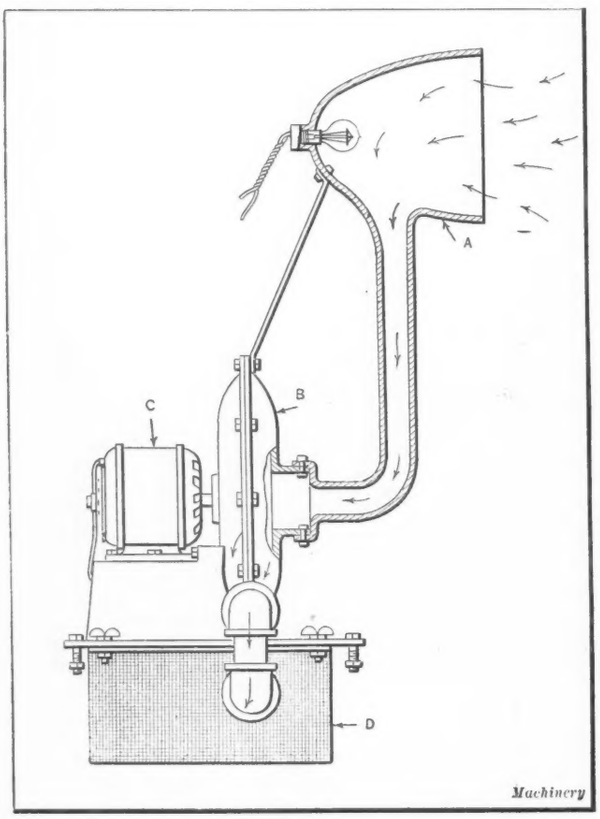
B·S
TRADE MARK

The new size is most convenient, slips right into the pocket, easy to handle and above all it lists the best tools you can buy.

PROVIDENCE, R.I., U.S.A.

MECHANICAL DEVICE HELPS FARMERS DESTROY INSECTS

Chemists and scientists have united in their efforts to produce poisons that would effectively combat crop-destroying insects, but with only partial or indifferent success. Now an inventor has developed a mechanical device for destroying night-flying insects that lay the eggs which produce the destructive boll-weevil, corn-borer, wire-worm, potato-grub, apple-worms, and a thousand other insect pests. Everyone has noticed how at certain seasons of the year millions of flies and insects swarm around lighted street lamps. It is this power of a light to attract insects that is utilized in the new insect destroyer. The device, as designed by the makers, Cross & Worden, Kenton, Tenn., has a combination funnel and powerful electric light reflector *A*, a suction turbine *B*, an electric motor *C* for driving the



Mechanical Device for destroying Insects

turbine, and a receptable *D* into which the insects are gathered. The powerful electric light throws a stream of illumination over a radius of 1000 yards or more, causing myriads of the insects to fly toward its source, where the electrically driven turbine sucks them into the mouth of the machine and down into the receptacle *D*.

Several years ago a similar device was developed and tried out in Germany. It is said to have been successful in so far as it attracted and annihilated great numbers of insects, but it appears that the supply was unlimited, and that the effect of the exterminating device on the number remaining was hardly noticeable.

* * *

Just as the electric inter-urban railroads cut heavily into the revenues of the steam railroads in the early days of the electric railway, so today the motor-bus is seriously curtailing the business of the inter-urban electric roads, and in some cases the motor-bus and the automobile, in conjunction, have put many of these roads entirely out of business. In order to hold their own to some extent, 115 electric railway companies now operate 1110 motor-buses over 1280 miles of road.

PERSONALS

R. D. Bean has been appointed chief engineer of the Brown Instrument Co., Philadelphia, Pa., manufacturer of indicating and recording instruments.

L. H. Mesker, who has been associated with the machine tool industry for many years, has recently become connected with the Cleveland Planer Co., Cleveland, Ohio.

L. W. Byrne, formerly connected with the Wilmarth & Morman Co., Grand Rapids, Mich., is now general manager of the Delahunty Dyeing Machine Co., Pittston, Pa.

B. W. Stone has resigned as manager of the New York branch office of the Kearney & Trecker Corporation, Milwaukee, Wis. Mr. Stone will be succeeded by W. P. Lotz.

Charles E. Coats, treasurer of the Coats Machine Tool Co., Inc., 110 W. 40th St., New York City, sailed July 26 on the steamship *Albert Ballin* for a six weeks' business trip to England, France, and Germany.

Walter L. Loegler has been appointed representative of the Warner & Swasey Co. in Philadelphia, Pa., where he will handle the sales in that territory. He has been with the sales department in the home office in Cleveland until his transfer of July 1.

S. E. Church, formerly of the S. E. Church Electric Co., electrical dealers of Chicago, Ill., has been appointed district manager of the Chicago office of the Triumph Electric Co. W. R. Bonham, who up to July 1 handled the Chicago interests of the Triumph Electric Co., has resigned.

Harry J. Swanson, since 1922 general sales manager of the Peerless Machine Co., Racine, Wis., and previous to that vice-president and general sales manager of the Detroit Machine Tool Co., has assumed the duties of vice-president and treasurer for the Detroit Piston Pin & Mfg. Co., Detroit, Mich.

H. L. Mode has joined the sales organization of the Florandin Equipment Co., 110 W. 40th St., New York City, and will specialize on the sale of "Lo-hed" hoists and Conkey cranes in northern New Jersey. Mr. Mode was formerly connected with the New York office of the Chesapeake Iron Works, manufacturers of cranes.

James B. Giern, formerly of the Giern & Anholtt Tool Works, and later with the Standard Service Tool Co., Detroit, Mich., of which he was vice-president and general manager, has severed his connection with the latter concern. Mr. Giern specializes in the designing and manufacturing of automobile service station equipment and tools.

W. L. R. Emmet, an official of the General Electric Co., Schenectady, N. Y., has been awarded the degree of Doctor of Science by Trinity College in recognition of his research and achievements in connection with the mercury-vapor turbine and boiler. Professor Elihu Thomson, one of the founders of the General Electric Co., and director of the Thomson Laboratory of the company at Lynn, Mass., was awarded the degree of Doctor of Science by the University of Manchester (England) on July 14.

William A. Durgin, for two and one-half years head of the Division of Simplified Practice of the Department of Commerce, has resumed his former post with the Commonwealth Edison Co., of Chicago, which he left temporarily to serve in the capacity mentioned. He is being succeeded by Ray M. Hudson, who has been assistant chief of the division since it was created. Mr. Hudson was connected for some years with the automotive industry. He was formerly with the Franklin Automobile Co., of Syracuse, N. Y., and later with the Holt Mfg. Co., Peoria, Ill.

Howard Bird, for several years general manager of the Canadian Pneumatic Tool Co., Ltd., Montreal, Canada, has been transferred to the position of managing director of the Consolidated Pneumatic Tool Co., Ltd., London, England, and director of European sales of the Chicago Pneumatic Tool Co., New York City, with headquarters in London, to succeed the late H. G. Megary. D. M. Wesbrook, formerly district sales manager of the Minneapolis branch of the Chicago Pneumatic Tool Co., has been made general manager of the Canadian Pneumatic Tool Co. to succeed Mr. Bird.

* * *

We have a new generation of railway operators. I have no hesitation in saying that with very few exceptions they have a high sense of public responsibility. They have given us a record of efficiency in management and consideration of public need, which has never been equalled in railway history—*Herbert Hoover*

Little Stories of Service and Savings

51 Cincinnati Millers in this Plant All Producing Profits

REMINGTON TYPEWRITER WORKS

SAYS—

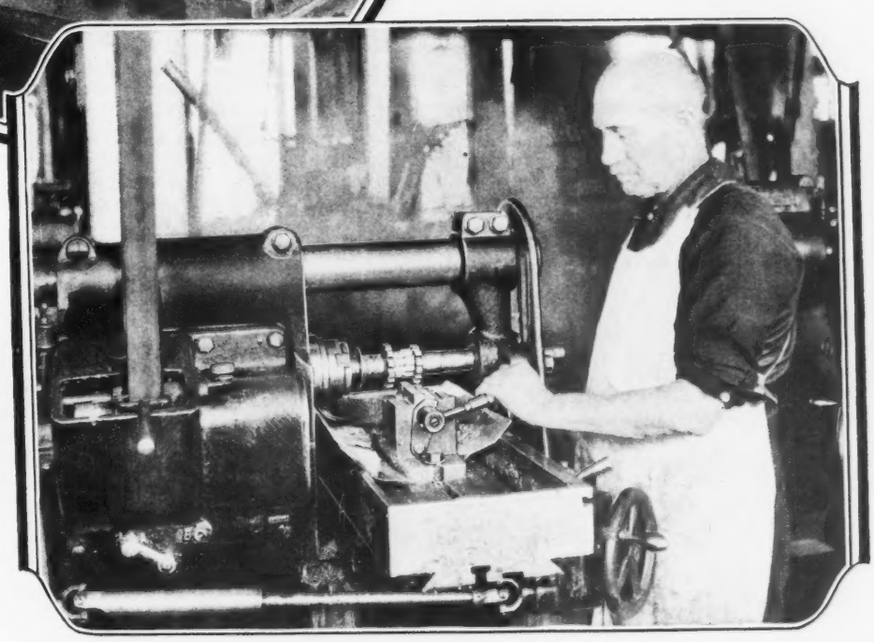
"The 51 Cincinnati Milling Machines which we have in our plant have resulted in a saving on practically every operation on which these machines are used.

"We consider Cincinnati Milling Machines well adapted for work produced in our factory."

A 24" Automatic Cincinnati Miller milling type bar guide for Remington Typewriter.

Certainly, the factory manager who wrote the above is in a position to know what Cincinnati Millers can do to increase production and reduce costs. Our Engineering Service Department is ready to co-operate with you and to give you the benefit of our 40 years' experience as milling experts. Whether your shop is a large one engaged in quantity production, or whether you are interested in a single machine, ask us to go over your work. Send for a Request for An Estimate blank—fill it out—return it—we'll do the rest.

The Cincinnati Milling Machine Co.
CINCINNATI, OHIO



An 18" Manufacturing Miller milling carriage rail seats on top plate on Remington Typewriter. This machine replaced two other milling machines and resulted in a saving in cost of 50% and a saving of 50% on floor space.

CINCINNATI MILLERS

TRADE NOTES

FAFNIR BEARING CO., New Britain, Conn., has moved its Chicago branch from 537 S. Dearborn St. to 2131 S. Michigan Ave.

NORTON CO., Worcester, Mass., has appointed Mitsubishi Shoji Kaisha, Ltd., of Tokyo, Japan, exclusive agent in the Empire of Japan, Formosa, Korea, Manchuria, and Shantung for Norton grinding machines. The New York office of the Japanese company is at 120 Broadway.

CLEVELAND STONE CO. announces that after August 1 its executive offices will be located on the thirteenth floor of the new Union Trust Building, Cleveland, Ohio. The grindstone, artificial abrasive, and building stone departments will all be located in the same quarters.

STROM BALL BEARING MFG. CO. has opened a distributing station at 2322 S. Michigan Ave., Chicago, Ill., for the convenience of automobile and truck dealers, service stations, repair shops, and car owners. A complete stock of Strom ball bearings for replacements will be available at this station.

CHICAGO PNEUMATIC TOOL CO., 6 E. 44th St., New York City, manufacturer of air compressors, has entered into an agreement with the Indiana Air Pump Co.; Indianapolis, Ind., manufacturer of air-lift equipment, whereby each organization will use jointly and exclusively the products of each other on their air-lift installations.

E. F. HOUGHTON & CO., Philadelphia, Pa., manufacturers of oils and leathers for industrial use, have awarded the Austin Co., Cleveland, Ohio, engineers and builders, a contract for additions to its Chicago branch plant. The new units include a compounding building, one-story with basement, and a two-story mill type building, 85 by 100 feet.

HUSKY WRENCH CO., 928 Sixteenth Ave., Milwaukee, Wis., has been incorporated with a capital stock of $50,000 to manufacture automotive and industrial socket wrenches of the interchangeable type. The officers of the company are: Joseph O. Wirtish, president; Siegmund Mandl, vice-president and chief engineer; and John G. Zummach, secretary-treasurer.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturer of automatic and semi-automatic arc, spot, butt, and seam welding machines, announces that the Chicago office of the company is now in charge of W. F. Hebard & Co., 551 W. Van Buren St., Chicago. Thomas Barnes will head the welding department and will be assisted by Charles Watson who has been associated with the Chicago office for the last two years. Mr. Hurd, who has represented the Gibb Instrument Co. in this territory for the last five years, will now look after the interests of the company in New England.

VICTOR TOOL CO., Madison & W. M. R. R., Waynesboro, Pa., manufacturer of collapsible taps, automatic die-heads, floating tool-holders and nut facing machines, has been merged with the LANDIS MACHINE CO., Waynesboro, Pa., manufacturer of threading die-heads and machines. In the future all correspondence applying to Victor products should be addressed to the Landis Machine Co., Victor Plant, Waynesboro, Pa. The trade name "Victor" will continue to be applied to the line of tools formerly made by the Victor Tool Co., and no change will be made in the selling arrangements of the Victor products. This merger enables the Landis Machine Co. to handle both internal and external threading requirements.

OBITUARIES

BENJAMIN G. LAMME, chief engineer of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., and one of the world's leading electrical authorities, died at his home in East Liberty, Pa., on July 8, after an illness of several months. Mr. Lamme was born on a farm near Springfield, Ohio, January 12, 1864. He entered the Ohio State University in 1883, and graduated in mechanical engineering in 1888. In 1889 he entered the employ of the Westinghouse Electric & Mfg. Co., with whom he had been associated ever since. Working in close association with George Westinghouse, he made many valuable contributions to electrical science. He had been granted individually more than 150 patents. Mr. Lamme was awarded the Edison Medal by the Institute of Electrical Engineers, and the Joseph Sullivant Medal by the Ohio State University, in recognition of the value of his work to the world.

H. A. IRWIN, Far East representative of the Landis Machine Co., Landis Tool Co., Warner & Swasey Co., and Kearney & Trecker Co., died at Tokyo, Japan, on June 22. Mr. Irwin was for a long period of years representative of the Landis Tool Co. in Europe, traveling extensively through France, Italy, Germany, Belgium, and England. About four years ago he became connected with the four companies by whom he was employed at the time of his death, as representative in the Far East, and travelled in Japan, China, and India in the interest of these concerns. He is survived by his widow who is at present in Japan, his parents, and several brothers and sisters who reside at McConnellsburg, Pa.

COMING EVENTS

SEPTEMBER 15-18—Machine tool exhibit at the Mason Laboratory, Sheffield Scientific School, Yale University, New Haven, Conn., under the auspices of the American Society of Mechanical Engineers, Yale University, and the New Haven Chamber of Commerce. Professor S. W. Dudley is in charge of the exhibit.

SEPTEMBER 16-19—Thirty-second annual convention of the Traveling Engineers' Association at the Hotel Sherman, Chicago, Ill. Secretary, W. O. Thompson, 1177 E. 98th St., Cleveland, Ohio.

SEPTEMBER 22-26—Sixth convention and international steel exposition of the American Society for Steel Treating, in Boston. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

SEPTEMBER 24-25—Automotive transportation meeting at the Society of Automotive Engineers' headquarters, Engineering Societies' Bldg., 29 W. 39th St., New York City. Coker F. Clarkson, secretary.

SEPTEMBER 28-OCTOBER 3—Tenth exposition of Chemical Industries at the Grand Central Palace, New York City. Manager of the International Exposition Co., F. W. Payne.

OCTOBER 3—Aeronautic meeting of the Society of Automotive Engineers at Dayton, Ohio.

OCTOBER 8-10—Annual convention of the National Machine Tool Builders' Association in Lenox, Mass.; headquarters, Hotel Aspinwall. General Manager, Ernest F. DuBrul, 630 Vine St., Cincinnati, Ohio.

OCTOBER 13-18—Twenty-eighth annual convention and exhibit of the American Foundrymen's Association in Milwaukee, Wis. Secretary, C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill.

OCTOBER 16-18—American Gear Manufacturers' Association's semi-annual meeting at Briarcliff Lodge, Briarcliff Manor, N. Y. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

OCTOBER 22-24—Production meeting of the Society of Automotive Engineers at Detroit, Mich. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NOVEMBER 18-19—Service engineering meeting of the Society of Automotive Engineers at Cleveland, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

DECEMBER 1-6—Third National Exposition of Power and Mechanical Engineering in the Grand Central Palace, New York City.

SOCIETIES, SCHOOLS AND COLLEGES

MONTREAL TECHNICAL SCHOOL, 70 Sherbrooke St., W., Montreal, Canada. Bulletin containing calendar for 1924-1925 for the day and evening classes.

DREXEL INSTITUTE, Thirty-second and Chestnut Sts., Philadelphia, Pa. Catalogue for 1924-1925, outlining the engineering and other courses offered by the institute.

POLYTECHNIC INSTITUTE OF BROOKLYN, Livingston and Court Sts., Brooklyn, N. Y. Catalogue of the College of Engineering for 1924-1925. Pamphlet outlining the evening technical courses offered by the institute.

COLUMBIA UNIVERSITY, Morningside Heights, New York City. Bulletin containing announcements of the afternoon and evening business courses for 1924-1925 offered by the University Extension. The winter session opens on September 24, 1924, and the spring session on February 4, 1925.

NEW BOOKS AND PAMPHLETS

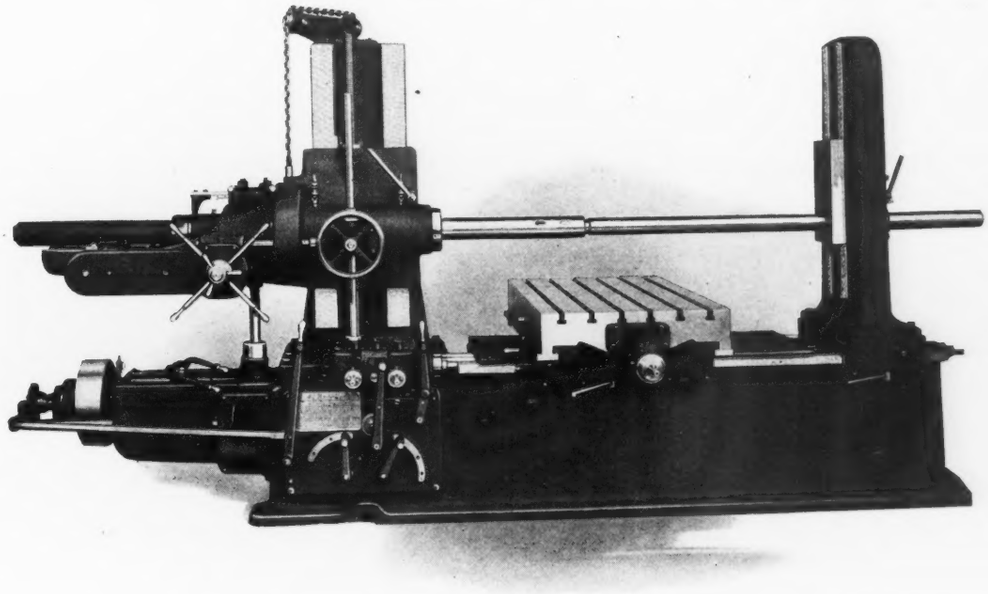
PERPETUAL INVENTORY AND STORES CONTROL. 26 pages, 6 by 9 inches. Published by the Department of Manufactures of the Chamber of Commerce of the United States, Washington, D. C.

AN INVESTIGATION OF THE FATIGUE OF METALS. By H. F. Moore and T. M. Jasper. 88 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 142 of the Engineering Experiment Station.

OUR AMERICAN SYSTEM OF WEIGHTS AND MEASURES—WHY WE SHOULD KEEP IT. 64 pages, 5 by 8 inches. Published by the American Institute of Weights and Measures, 115 Broadway, New York City.

This pamphlet is written as a protest against changing from the English system of measurements to the metric system. The five parts into which the text is divided are headed as follows: Systems of Measurements; Advantages of Eng-

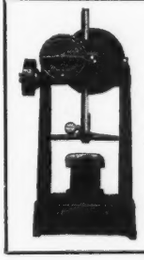
Quality Must Be Paramount—
We Do No Trading on Past Reputation



The Quality of the

"PRECISION"

Boring, Drilling and MILLING MACHINE



WE ALSO MAKE THE
LUCAS POWER
Forcing Press

is not only kept up, but improved whenever possible.

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich, V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo.

lish Units Over Metric; Should We Be Compelled to Abandon Our Customary System?; Industry and the Metric System; General Information and Conclusions.

BETTER FOUNDRY PRACTICE. 22 pages, 5¼ by 7½ inches. Published by the Policyholders' Service Bureau of the Group Insurance Division of the Metropolitan Life Insurance Co., New York City.

This is the first of a series of ten descriptive studies of management practices in the foundry. Fifty-four foundries located in various parts of the United States were visited and careful observations made of plant, organization, and management practices. From these observations, examples have been assembled of methods actually in use which have resulted in better operations, improved working conditions, and reduced costs. The subject of the present pamphlet is the building.

PRACTICAL MATHEMATICAL ANALYSIS. By H. Von Sanden. 195 pages, 5¾ by 8¾ inches. Published by E. P. Dutton & Co., 681 Fifth Ave., New York City. Price, $4.50.

This book is based on the work included in Professor Von Sanden's courses in numerical and graphical calculation at the University of Gottingen, and presents to the reader a survey of the methods by which the solutions of any given problem may be evaluated in numerical form. The book bridges the gap between the solutions of pure mathematics and practical numerical solutions required by physicists and engineers. The author has given preference to those methods that are capable of general application in the teaching of mathematics, and consequently has devoted considerable space to the treatment of empirical functions. The subjects treated include: The Slide-rule; the Calculating Machine; Rational Integral Functions, and their Extrapolation and Interpolation; Arbitrary Functions, and their Interpolation; Numerical Differentiation and Integration; Mechanical Quadrature; Integration and Differentiation by Graphics; Analytical Approximation to Empirical Functions; Solution of Equations, Linear, Transcendental and Non-linear; Integration, Graphical and Numerical, of Ordinary Differential Equations of the First, Second and Higher Orders.

ARC WELDING HANDBOOK. By C. J. Holslag. 250 pages, 4¾ by 7½ inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $2.

This book is intended to serve as a manual of instruction in arc welding. An attempt has been made to describe the methods, step by step, so that the beginner may understand both the equipment and the processes. In order to adapt the book for school use, questions have been added at the end of each chapter. The text is divided into twenty-five chapters, dealing with the following subjects: Preliminary Instructions and Holding the Arc; Bead Forming; Spreading Welding; Padding Welding; Overhead Welding; Fillet Welding; Lap Welding; Butt Welding; Special Butt Welds and Hole Filling; Irregular Tube Shapes; Tack Welding; Patching Sheets; Tank and Boiler Welding; Welding Heavy Sections; Welding Cast Iron and Malleable Iron; Welding Thin Sections in Cast Iron; Useful Arc Welding Methods and their Application; Welding of Structural, Sheet-iron, Plate, and Angle Work; Welding of Non-ferrous Metals and Use of Carbon Arc; Electric Arc Cutting; Welding of Alloy Steels; Welding Test Pieces; the Electric Welding Arc and the Eyesight; Use of Gas, Electric, and Thermit Welding, and Electrodes of Various Types; Rigidity vs. Flexibility in Arc Welding.

NEW CATALOGUES AND CIRCULARS

MICROSCOPES. Bausch & Lomb Optical Co., Rochester, N. Y. Circular descriptive of the FFS microscope.

FANS. Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. Form 1903, descriptive of man cooler fans—their application and effect.

MOTORS. Reliance Electric & Engineering Co., 1056 Ivanhoe Rd., Cleveland, Ohio. Bulletin 2016, descriptive of Reliance type T heavy-duty planer motors for reversing service.

CONNECTORS AND PIPE HANGERS. Crouse-Hinds Co., Syracuse, N. Y. Folder No. 13, illustrating different types of connectors for conduit and cables. Bulletin 2058, illustrating "Wedgtite" pipe hangers.

DIESEL ENGINES. Fulton Iron Works Co., St. Louis, Mo. Bulletin 806, entitled "The Fulton-Diesel in Industry," illustrating the application of Fulton-Diesel engines in a number of different kinds of plants.

CHUCKS. Cushman Chuck Co., Hartford, Conn. Catalogue 42, containing data on Cushman chucks, including independent chucks and faceplate jaws, geared scroll self-centering chucks, triplex chucks and two-jaw chucks.

OIL-CUPS. Gits Bros. Mfg. Co., 1911 S. Kilbourne Ave., Chicago, Ill. Catalogue 20, covering the line of lubricating devices and oil-cups made by this concern. Complete tables of dimensions are included, as well as a brief general description.

WRENCHES. Lakeside Forge Co., Erie, Pa. Catalogue 14, covering this company's line of drop-forged wrenches, which includes both open-end and adjustable wrenches. Weights of wrenches and comparative wrench numbers are given in tabular form.

SUPERHEATERS. Superheater Co., 17 E. 42nd St., New York City. Booklet entitled "Origin, Development, Results of 'Elesco'," giving, in brief form, the history of the company and the growth of its operations in producing "Elesco" superheaters.

ANTI-FRICTION BEARING METAL. Magnolia Metal Co., 113 Bank St., New York City. Pamphlet containing a discussion of the properties of Magnolia anti-friction metal, together with instructions for the making and operation of lined bearings for economical service.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Circular entitled "New Departures Again," containing pictures of the automobiles that won the races at Indianapolis on Memorial Day. It is pointed out that these cars were equipped with New Departure ball bearings.

THREAD GAGES. John-Sons Gage Works, 67 Blue Hills Ave., Hartford, Conn. Catalogue of the line of screw thread gaging and measuring tools made by this concern, which includes adjustable thread snap gages, setting plugs, gage vises, gage fixtures, and lead tester comparators.

MOTORS. Wagner Electric Corporation, St. Louis, Mo. Bulletin 133, illustrating and describing in detail "Pow-R-full starterless" motors. The advantages of this type of motor are pointed out, and information is given on safety requirements of starterless motor installations.

ELECTRIC CONTROLLERS. Electric Controller & Mfg. Co., Cleveland, Ohio, is publishing a periodical called "Current News" which contains news items about applications of the various products of the company as well as other information of interest to users of electricity.

DRAFTING-ROOM FURNITURE. C. F. Pease Co., 822 N. Franklin St., Chicago, Ill. Catalogue F24, illustrating and describing a complete line of drafting-room furniture, including drawing boards and tables, stools, cabinets, filing cases, universal drafting machines, etc.

SAFETY SWITCHES AND PLUGS. Crouse-Hinds Co., Syracuse, N. Y. Circular descriptive of the MKS series of interlocking safety switches and plugs, which are intended for use with portable electrical appliances such as welding machines, rivet heaters, motor-driven machines, etc.

LIFT TRUCKS. Sturdi-Truck Mfg. Co., Inc., 511 Orange St., Wilmington, Del. Pamphlet entitled "The Sturdi-Truck Material Handling Service," containing an outline of the distinctive features of this type of truck, specifications for the various sizes, and views showing applications in various industries.

WELDING AND CUTTING EQUIPMENT. Oxweld Acetylene Co., Thompson Ave. and Orton St., Long Island City, N. Y. 48-page catalogue, illustrating and describing in detail this company's line of acetylene generators and oxy-acetylene welding, cutting, brazing, lead burning, heating, and decarburizing equipment.

MANGANESE STEEL CASTINGS. American Manganese Steel Co., Chicago Heights, Ill. Catalogue 9, treating in considerable detail of "Amsco" manganese steel castings. A brief description is given of manganese steel and how it is made, followed by a description of its application in a wide variety of industries.

TAPS AND DIES. Winter Bros., Wrentham, Mass. Catalogue 15, covering the products of this company, which include carbon and high-speed steel taps and dies, ground thread taps, and screw plates. Tables of specifications, including sizes and prices of the various tools, are given, and the book is provided with a handy thumb index.

LOCOMOTIVE JOURNAL TURNING MACHINE. Chester B. Blakeman, Atlanta, Ga. Pamphlet illustrating and describing the construction, application, and operation of the Marsh portable locomotive journal turning machine, which is designed to true up journals on the driving wheel axles of a locomotive without removing the drivers.

BENCH LATHES. B. C. Ames Co., Waltham, Mass. Circular descriptive of the Ames No. 3 bench lathe, a machine especially designed for precision work but which may also be adapted for performing turning, drilling, grinding, milling and thread-grinding operations on a production basis by the use of special interchangeable fixtures.

CONSULTING ENGINEERING. H. L. Swoboda, Inc., consulting engineers, Pittsburg, Pa. Pamphlet entitled, "Why Pay for Engineering Services?" containing an article reprinted from the *Electrical World* in which the need of the services of the electrical engineer in constructing and reconstructing electric light and power equipments is pointed out.

FLAT TURRET LATHES. Jones & Lamson Machine Co., Springfield, Vt. Pamphlet entitled "The Problems of Your Shop—its Work and Equipment." This is the first of a series of pamphlets on shop problems, the present one discussing equipment. The various sizes and styles of J. & L. flat turret lathes are illustrated, and with each machine is shown a group of parts typical of the range of work it is adapted to turn out.

WORM-GEARING. Hindley Gear Co., 1105 Frankford Ave., Philadelphia, Pa. Catalogue 6, of Hindley worm-gears and spirals, containing complete dimensions of the different sizes. The pamphlet also includes a list of standard hobs for cutting straight worm-gears, as well as dimensions of standard parts for worm-gear housings. The last part of the book contains illustrations of applications of the Hindley worm-gear in various types of machines.

ELECTRIC DRILLS. Van Dorn Electric Tool Co., Cleveland, Ohio. Catalogue entitled "Higher Holeage—Lower Costs," containing information on the line of electric drills produced by this company. The pamphlet opens with a chapter on the history of "hole-making," which is followed by a description of the use of Van Dorn electric drills in various classes of work, as well as illustrations and specifications covering the different sizes and types of drills.

MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 30 AUGUST, 1924 Number 12

PRINCIPAL ARTICLES IN THIS NUMBER

Automatic Milling—*By Franklin D. Jones*..... 919
Unusual Engine Lathe Operations—*By Joseph Lannen, Andrew J. Weis* and *C. T. Ketz* 927
Design of Magazine Carriers and Slides—*By Albert A. Dowd*..... 931
The British Metal-working Industries..... 935
Current Editorial Comment 936
The Design of Automatic Machinery—When to Use Tables or Diagrams—Standardizing Machine Tool Motors—Machine Tool Lubrication
Encouraging Suggestions from Your Men—*By K. C. Monroe*..... 937
Planetary Gearing—*By F. DeRonde Furman* 938
Manufacturing Interchangeable Counterbores—*By Charles O. Herb*..... 943
Possibilities of Heavy-duty Drilling—*By Herbert L. Tigges*..... 950
Plate and Coil Clutches—*By Albert Clegg*..... 953
Short-center Belt Drives—*By Gustave A. Frenkel* 956
Making Thread Gages—*By Carroll D. Edgar* 959
Work of the Bench Lathe—*By Franklin D. Jones* 960
Causes of Spring Failures—*By J. W. Rockefeller, Jr.* 965
Tools and Fixtures for Turning Eccentrics—*By F. H. Mayoh*..... 976
The Machine-building Industries..... 982

DEPARTMENTS

Notes and Comment on Engineering Topics 926
What Our Readers Think 942
MACHINERY'S Scrap-book 948
Letters on Practical Subjects 967
Shop and Drafting -room Kinks..... 972
Questions and Answers 973
New Machinery and Tools 983

Circulation for July, 18,240 Copies Member Audit Bureau of Circulations

Product Index 240-264 Advertisers Index 267-268

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

ALEXANDER LUCHARS, President ROBERT B. LUCHARS, Secretary
ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor
LONDON: 52 Chancery Lane PARIS: 121 Rue Lafayette

YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 35 cents.

Copyright 1924 by The Industrial Press. Entered as second-class mail matter, September, 1894, at the Post Office in New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America.

"Wheels Within Wheels"

Planetary Gearing

If you have ever tried to analyze and solve planetary gear problems you know why the expression "wheels within wheels" is commonly used by engineers and mechanics as a symbol for that which is complex and difficult to understand. In planetary gearing there are literally wheels within wheels, with perplexing and mysterious motions; and yet, the knottiest of these problems may be solved by using ordinary arithmetic and the results may be checked by a simple graphical method.

For years MACHINERY has been searching for a simple and complete treatise covering Planetary Gearing and in this number, August, has the satisfaction of presenting to its readers the first of a series of articles on Planetary Gears, written by Franklin DeRonde Furman, Professor of Mechanism and Machine Design at Stevens Institute of Technology. This preliminary article will be followed during the next fourteen months by others until finally the entire subject has been explained step by step.

There is hardly a draftsman who has not at some time been confronted with a problem involving planetary gears. This number of MACHINERY, and the numbers following, will contain the first complete and simplified treatise on this important and perplexing subject. You need MACHINERY.

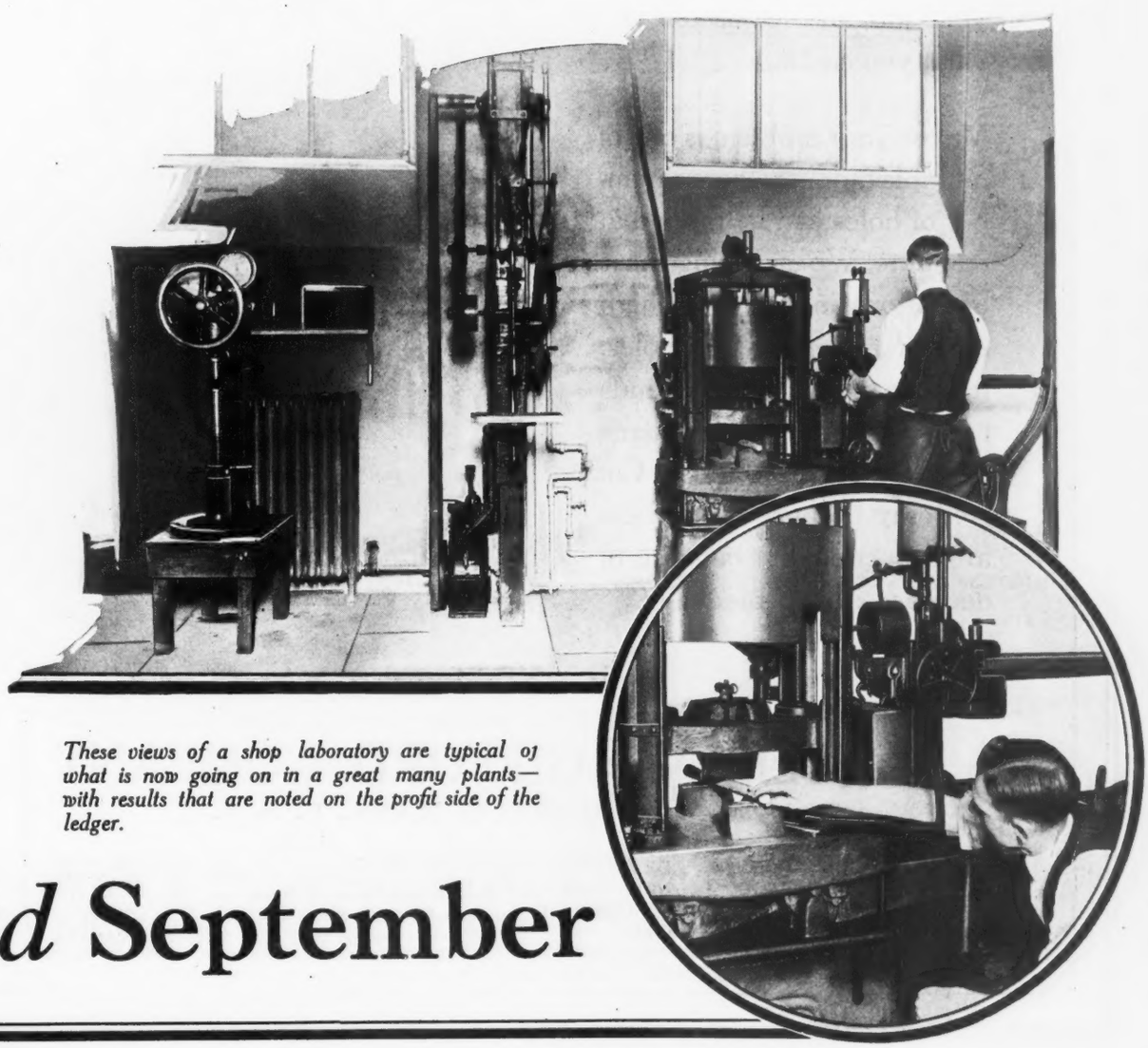
MACHINERY *for* August

The Advantages of a Shop Laboratory

Until quite recently few machine shops, not excepting even the largest plants, have had research laboratories. The advantages of specialized scientific research have become so very apparent however that many of the leading shops have now installed, and others are planning the installation of excellent laboratories for testing and inspecting, by physical and chemical tests, all the important materials that pass into the plant. Some have gone even further and have begun to investigate the reasons for defects in materials; with the reasons for failure established it is then possible to eliminate the defects. In September MACHINERY the leading article will describe the manner in which such a shop laboratory has improved the product of one plant.

"Belting Materials," an article by Gustave A. Frenkel, to appear in September MACHINERY, will interest readers in practically every industrial field. It discusses the physical properties and general characteristics of belting made from leather, rubber, cotton and steel.

Among other articles to run in September are "The Work of the Bench Lathe," "Heat-treatment of Steel Springs," "Continuous Heat-treating Furnaces," "Stellite as a Material for Gages"—a wide range of subjects and everyone right to the point.

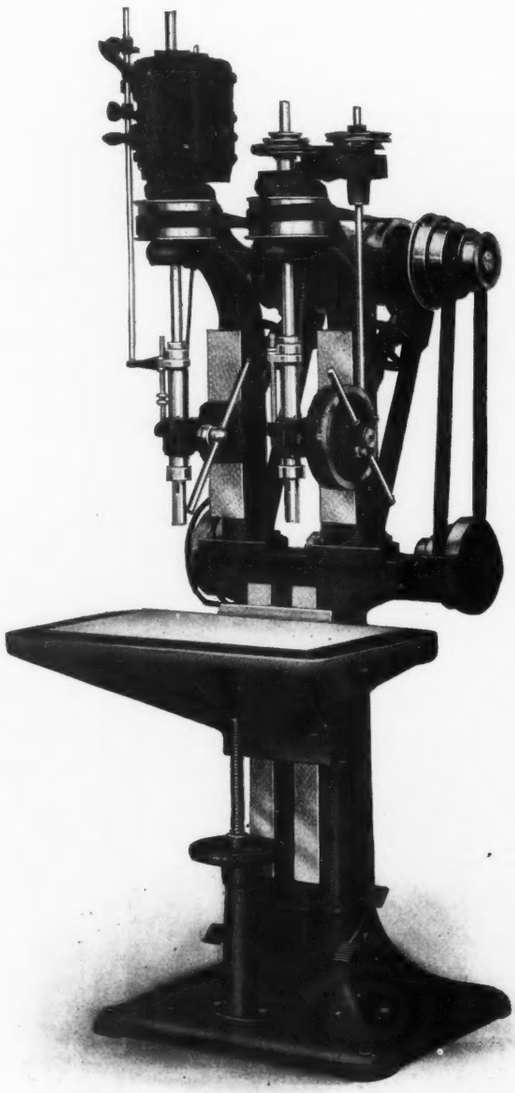


These views of a shop laboratory are typical of what is now going on in a great many plants—with results that are noted on the profit side of the ledger.

t *and* September

What About Your Tapping?

Do you realize that LELAND-GIFFORD Company has tapping machines which tap small holes at 4,000 R.P.M.? It is not at all unusual to get an increase in production of 300-400% over previous methods when such speed is used. If you are not running your small taps as fast as this, it would pay you to let us have an outline of your job, and let us tell you what you can do.



Maybe your problem is one of multiple tapping where a number of holes can be tapped at one time. We are doing these operations in the same high speed manner as single holes. It will pay you big dividends to take your tapping problems up with Leland-Gifford Co. Not only because of increase in production, but because of decrease in tap breakage.

LELAND-GIFFORD COMPANY

WORCESTER, MASS., U. S. A.

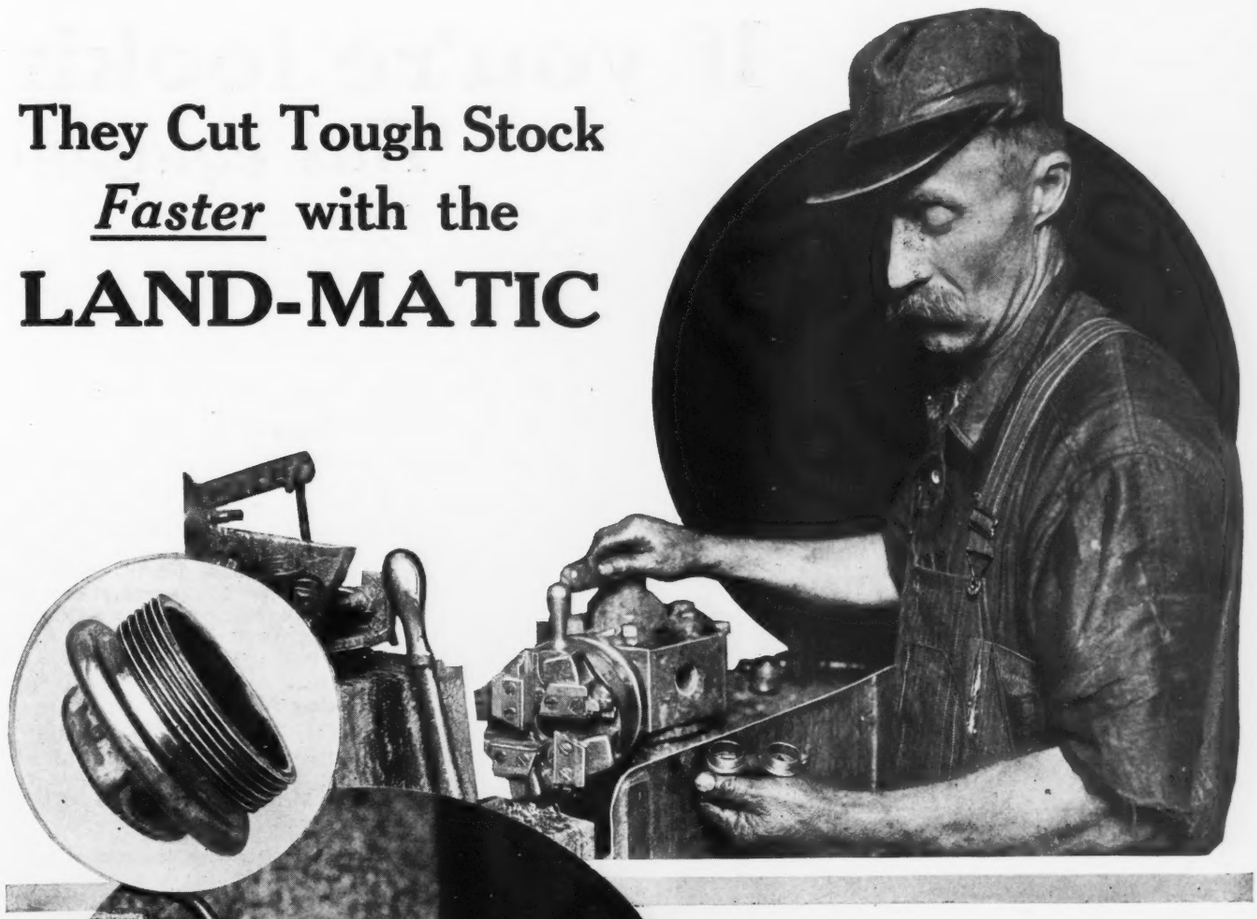
Branches

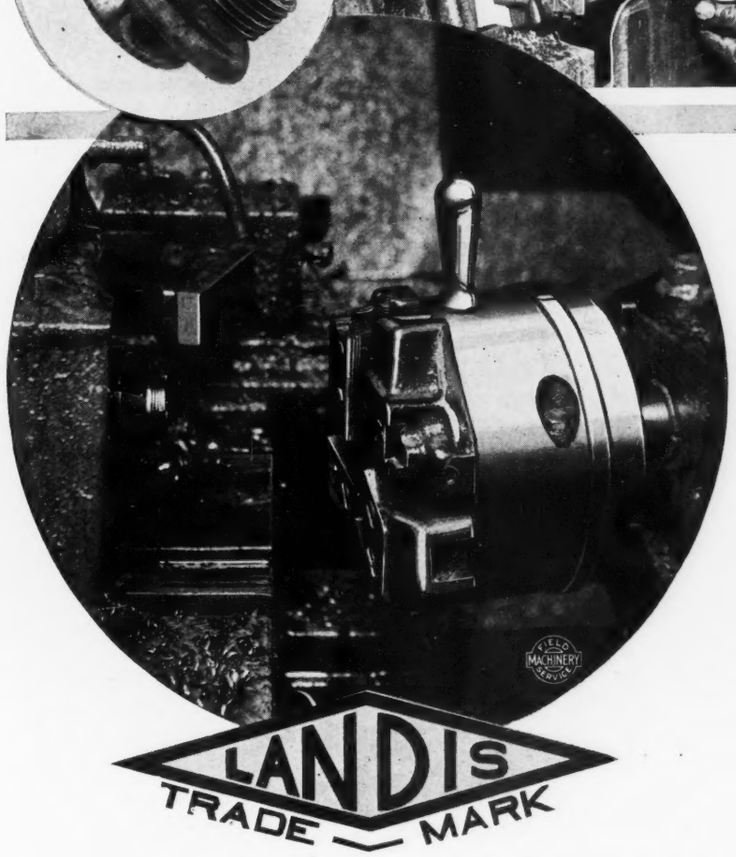
BOSTON — DETROIT
CHICAGO — NEW YORK
CLEVELAND — PITTSBURGH
ROCHESTER

Agents

Hendrie & Bolthoff, DENVER, COLO.
F. E. Satterlee Company MINNEAPOLIS, MINN.
Colcord-Wright Machy. & Supply Co., ST. LOUIS, MO.
Herberts Machy. & Supply Co., LOS ANGELES / SAN FRANCISCO
F. F. Barber Machy. Co., TORONTO, CANADA

They Cut Tough Stock *Faster* with the LAND-MATIC





The work of threading these pressed steel plug caps for rear axle housings and transmission cases is extremely difficult because the metal has been through *four* drawing operations, which have upset the grain and made the steel very tough.

This stock is so hard on dies that no die could be found that would do the work without regrinding about four times a day. Then Land-Matic Die Heads were tried and "Land-Matics" have *stayed* on the job. They thread continuously for a whole ten-hour day per grind and have boosted production 40 per cent.

Production with "Land-Matics" is 200 caps $1\frac{1}{8}$" in diameter, 20 threads per inch, by 9/32" long per hour. Limits .0015 inch.

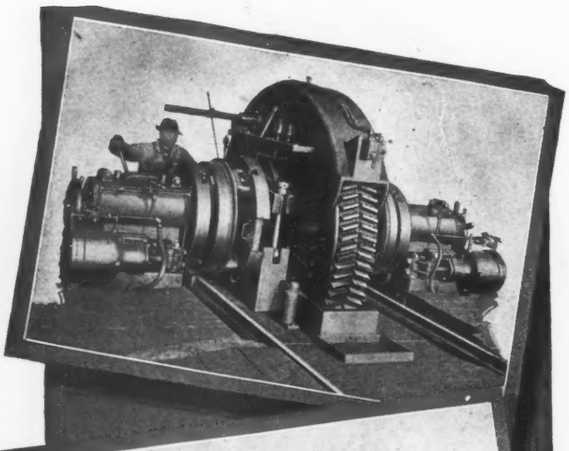
Try "Land-Matics" and watch them stay on *your* job.

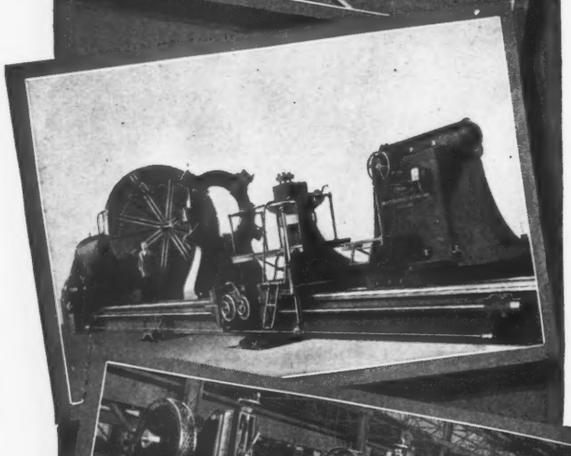
LANDIS MACHINE COMPANY, Inc., Waynesboro, Pa.

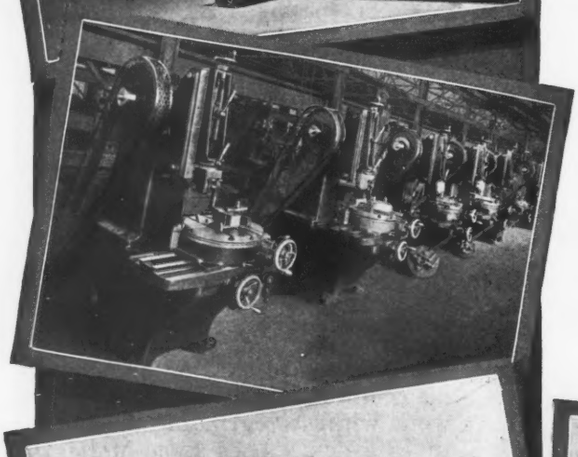
DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Co. of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; R. B. Whitacre & Company, St. Paul, Minn.; Hamilton Machinery Co., Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala.; Woodward, Wight & Co., New Orleans, La.; Jos. T. Ryerson & Sons, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; Herberts Machinery & Supply Co., San Francisco, Calif.; Herberts Machinery & Supply Co., Los Angeles, Calif.; Harry M. Euler Co., Portland, Ore.; Hallidie Machinery Co., Seattle, Wash.; Hallidie Co., Spokane, Wash. CANADIAN AGENTS: Canadian Fairbanks-Morse Co., Toronto and Montreal.

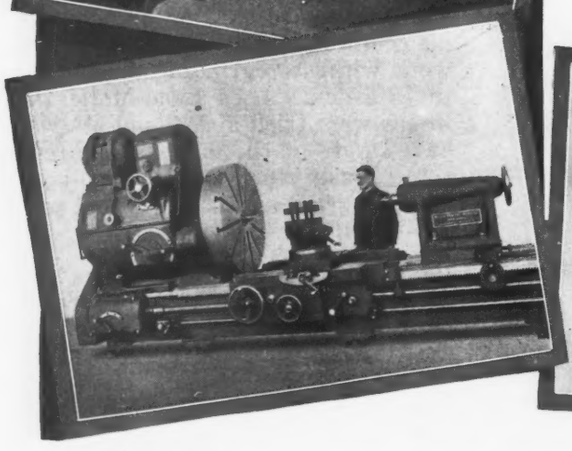
If you're looking fo

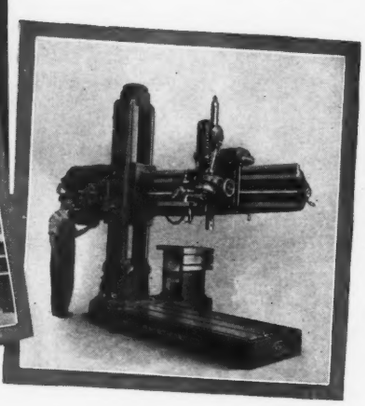
This equipment wi











Right Line Radials

THE experienced drill hand takes to this machine on sight. Every control device that is used during the drilling operation is within arm's reach at the head. The electric column clamp from the head saves valuable time on every job. The new method of driving direct to spindle from motor mounted on the arm delivers more power to the tool and simplifies design. ***Catalog No. 247-1.***

Planers

IN SIZES from 26 in. to 14 ft. and larger, N.B.P. Planers are modern throughout. The Reversing Motor Drive first introduced more than 12 years ago has made them unequalled for efficiency, low power consumption and light cost of maintenance. Other features that for the most part orginated with these machines include box type table, improved gear drives, rapid traverse to rail and side heads, pendant switch for convenient, safe control in setting up and operating, and our "Super Control" Drive which makes reversing motor drive available for A.C. as well as D.C.

Boring Mills

STARTING with our 36-44-in. Side Head Boring Mill (a high production manufacturing machine with rail turret and side head) N.B.P. Boring Mills range from the small and medium sizes up to the 36-ft. machines for large electric units and marine work.

Horizontal Boring Machines — Our line includes cylinder borers; also horizontal boring, drilling and milling machines in all sizes and types from the "Duplex Control" Borers with a swing of 60 in. and 72 in. up to the largest floor borers.

R. R. Wheel and Axle Machinery

WE ARE the world's largest manufacturer of this equipment, which has hung up production records in railroad shops everywhere. N.B.P. Carwheel and Driving Wheel Lathes, Axle and Journal Turning Lathes, Wheel Presses, Carwheel Borers, etc., are built to take full advantage of the possibilities of high speed steel cutting tools. Electrical control features that lighten labor and save time are supplied on all larger units.

Bement Hammers

A STYLE and size for every sort of work. Single Frame Forge Hammers from 250 to 4000 lbs.; double frame Forge Hammers from 1300 to 24,000 lbs.; Steam Drop Hammers from 600 to 12,000 lbs.

Other Steam Hammers may look like Bements but the test of actual service shows the difference.

Niles Cranes

NILES Cranes are made in all sizes from 5 to 250 tons and larger, and in electric traveling, jib, wall and gantry types. Built in a plant that makes cranes exclusively and that has twenty-five years' experience in crane construction behind it to ensure highest quality.

NILES-BEMENT-POND N-B-P NEW YORK U.S.A.

NILES-BEMENT-P

General Offices: 111 Broadway, New York City

for PRODUCTION!

will help you

Pratt & Whitney Lathes

Bench, Toolmakers' and Precision Lathes
Full Automatic Engine Lathes

FROM our little 7 in. Bench Lathe up to the 16 in. Model B Engine Lathe (our latest design) we maintain the same P.&W. accuracy, quality and high grade of workmanship and design. The 13- and 16-in. Model B Lathe is the only lathe on the market having hardened and ground gears in the headstock. Another innovation is the direct reading indexing for both the speed and feed change lever settings.

Full Automatic Engine Lathes — highly accurate manufacturing machines for work that cannot be chucked. Two sizes, for work up to ⅝ x 12 in. and 1⅛ x 18 in. Great savers on labor costs. *Catalog No.* 284-1.

P. & W. Vertical Surface Grinders

For Increased Production—Greater Accuracy and Better Finish

PRATT & WHITNEY Surface Grinders will handle with equal facility, work requiring either rotary or longitudinal movement. Three sizes ranging from the small rotary machine with 8 in. wheel and 10 in. chuck for such work as small gear blanks, washers, rings, etc., the medium size with 14 in. wheel up to the largest size with 22 in. wheel and with 4 ft. and 7 ft. table for industrial and railroad shop work such as guides, links, rods, etc.

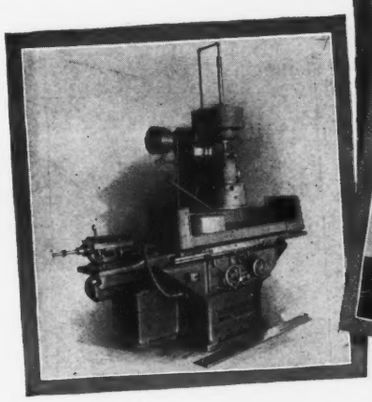
P. & W. Vertical Shapers

BUILT in two sizes, 6 in. and 10 in. stroke. Combining the advantages of both the slotter and horizontal shaper, these machines have great accuracy and a wide field of usefulness. Furthermore, ram can be swung out to 5 deg. from vertical, an invaluable feature for clearances on die work. Swiveling ram head permits finishing work complete in one setting. Circular No. 269.

P. & W. Adjustable Multiple Spindle Drills

NOTED for their exceptional stability, ease and convenience of adjustment and wide application in manufacturing. Furnished with number of spindles to meet requirements.

Equipped with back geared heads, horizontal and vertical spindle adjustment, power feed to table with automatic knock-off and positive adjustable stop. ***Write for circulars.***

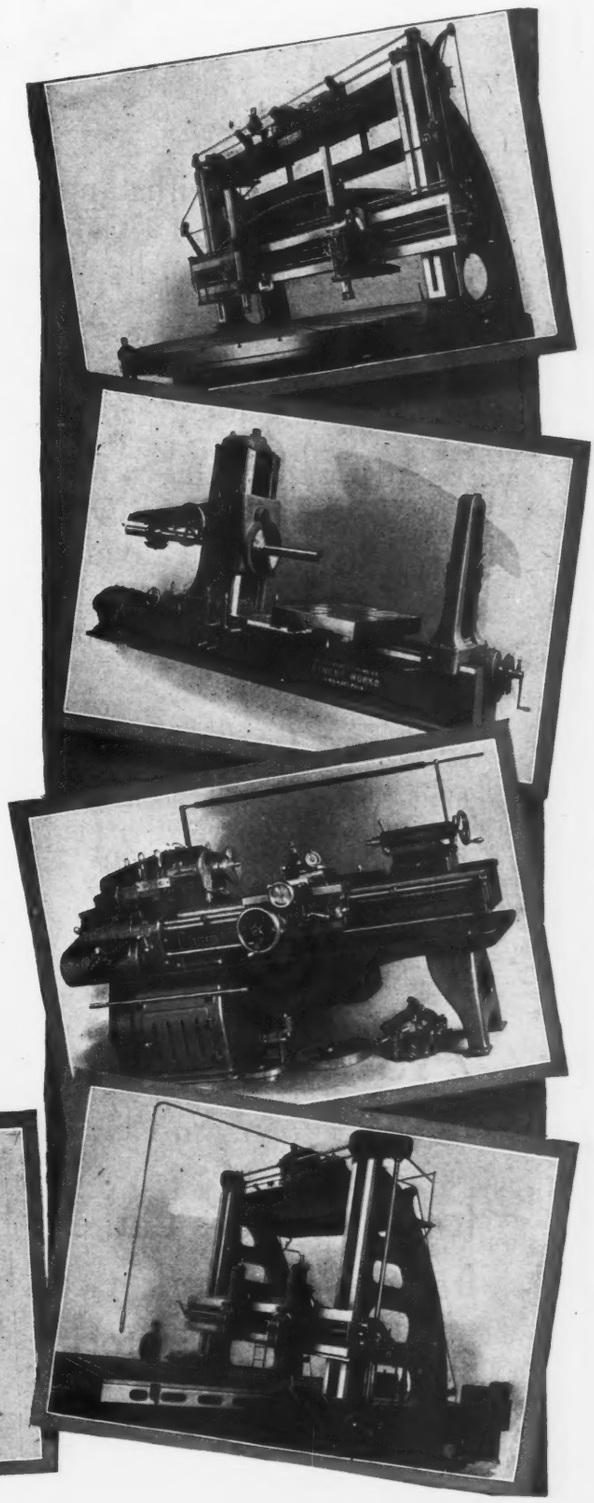


Pratt & Whitney Taps, Dies, Reamers, Milling Cutters

NO other manufacturer makes such a variety of small tools. 41 styles of taps; 17 styles of dies; 33 styles of milling cutters; 39 styles of Reamers; 11 types of Drills, are listed in our catalog. Also Punches, Screw Plates and Miscellaneous Tools, all of highest quality.

Gages

P. & W. Gages are standard wherever control of size is essential. Measuring Machines, Bench Micrometers, Hoke Gage Blocks, Snap Gages, Cylindrical and Thread Gages, Pipe and Casing Gages, etc. Have you a copy of Catalog No. 11?



T.POND COMPANY

SALES OFFICES: New York Rochester Boston Philadelphia Cleveland Pittsburgh Detroit
Chicago St. Louis Cincinnati Birmingham St. Paul San Francisco Los Angeles

NILES-BEMENT-POND N-B-P NEW YORK U.S.A.

Solid as a

Built to last; to withstand the strains of continuous work; a veritable Gibraltar—is the DUOMATIC! This rigidity is brought about *not* by weight alone but by unusually sound construction.

Special attention was given to rigidity from the very first conception of this lathe. An automatic machine is just as good as it is rigid and it will retain its effectiveness just so long as that rigidity is present.

When accuracy and rigidity are conspicuously present in one machine, that is the one which will pay dividends. Not only dividends in dollars and cents but dividends in satisfaction. To know you have installed an automatic that will handle your work effectively and save you money is without doubt a satisfaction difficult to measure in dollars and cents.

The Lodge & Shipley DUOMATIC will do this!

For over a year a good number of DUOMATICS have been in use around the country. They have all made good! What more convincing proof could there be that this machine is past the experimental stage?

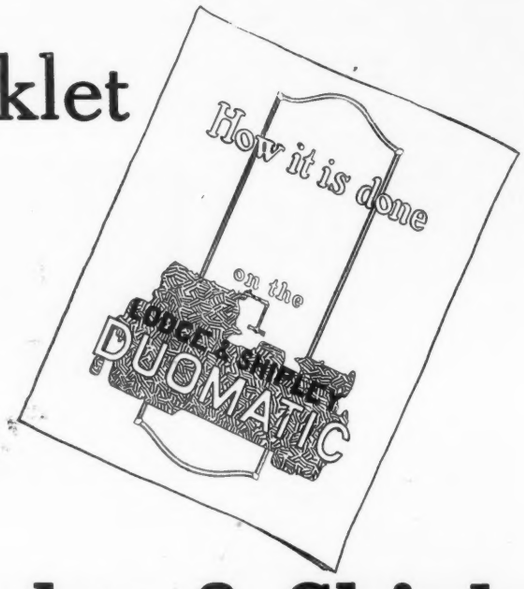
They have made good chiefly because they were made right—***as solid as a rock!***

Ask for this booklet

No Obligation

It tells how this Lathe is built
It shows the work it can do
It tells the whole story!

Send for it today!



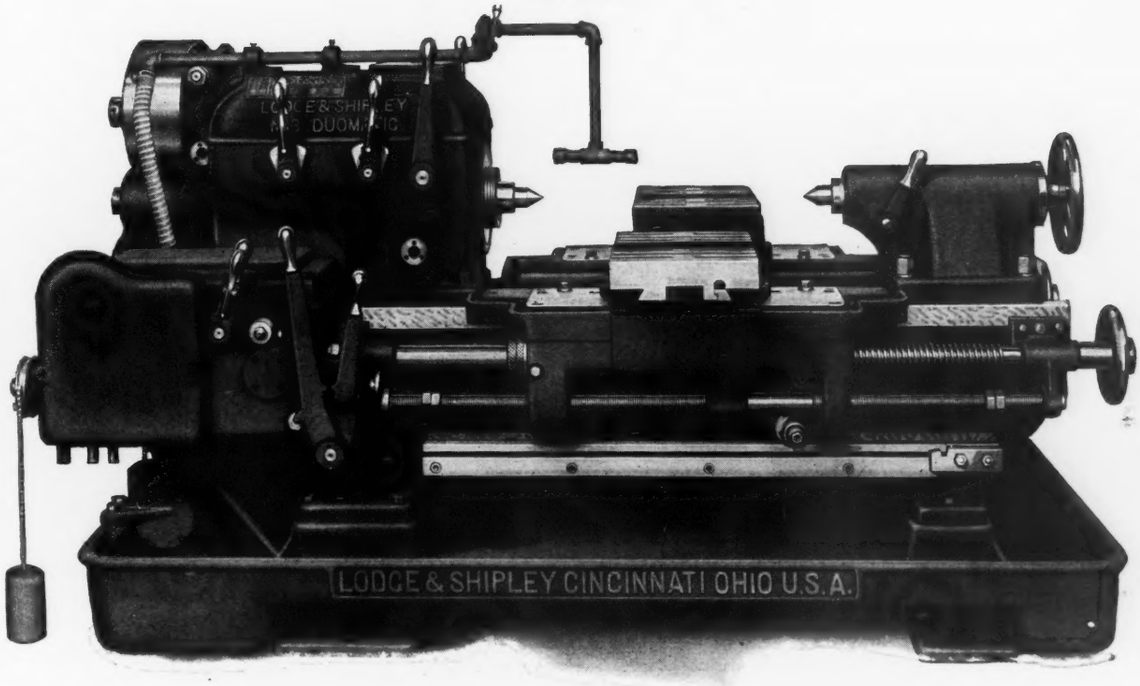
The Lodge & Shipley

Cincinnati,

s a rock!

The
Lodge & Shipley
DUOMATIC

PATENTED



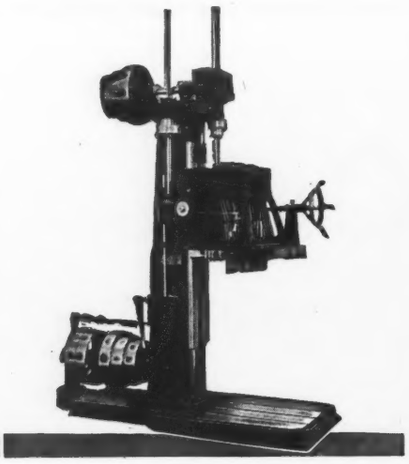
The Lodge & Shipley DUOMATIC Lathe

embodies new ideas that will meet with your instant approval. Such features as two automatic independent carriages that can be used simultaneously put it into a class by itself. We would like to have you read about this machine.

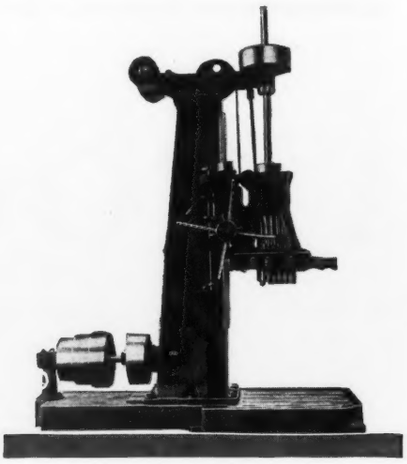
Send for a copy of the booklet now

Machine Tool Company
Ohio

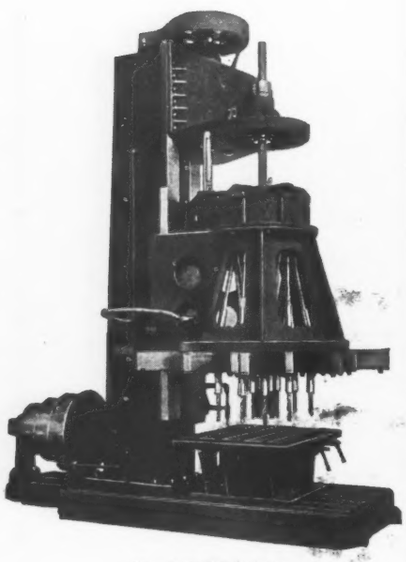
No. 1 Multiple



No. 2 Multiple



No. 3 Multiple



No. 30 Multiple

BAUSH

Vertical and Horizontal Multiple Spindle Drills

Staybolt Threading and Reducing Machines

Bolt Turning Machines

Worm Gears

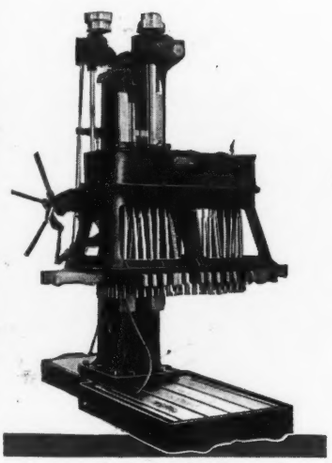
Manufactured by

Baush Machine Tool Company
Machine Tool Division
Springfield, Mass.

Cleveland Office—302 Leader Bldg.
Chicago Office—751 Peoples Gas Bldg.

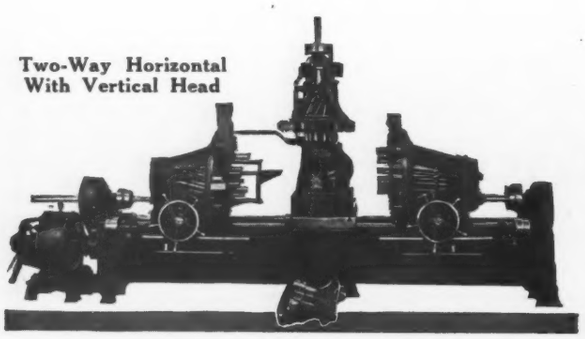
Detroit Office: Dime Savings Bank Bldg.
Domestic Representatives:
Manning, Maxwell & Moore

Foreign Representatives:
Alfred Herbert, Coventry, England
Fenwick Freres & Co., Paris, France

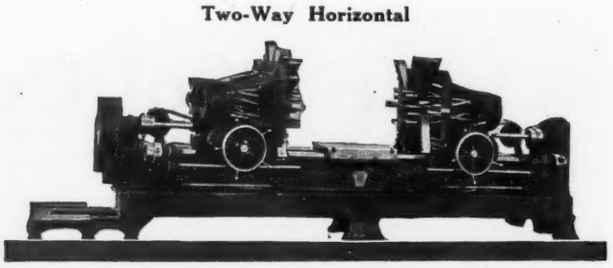


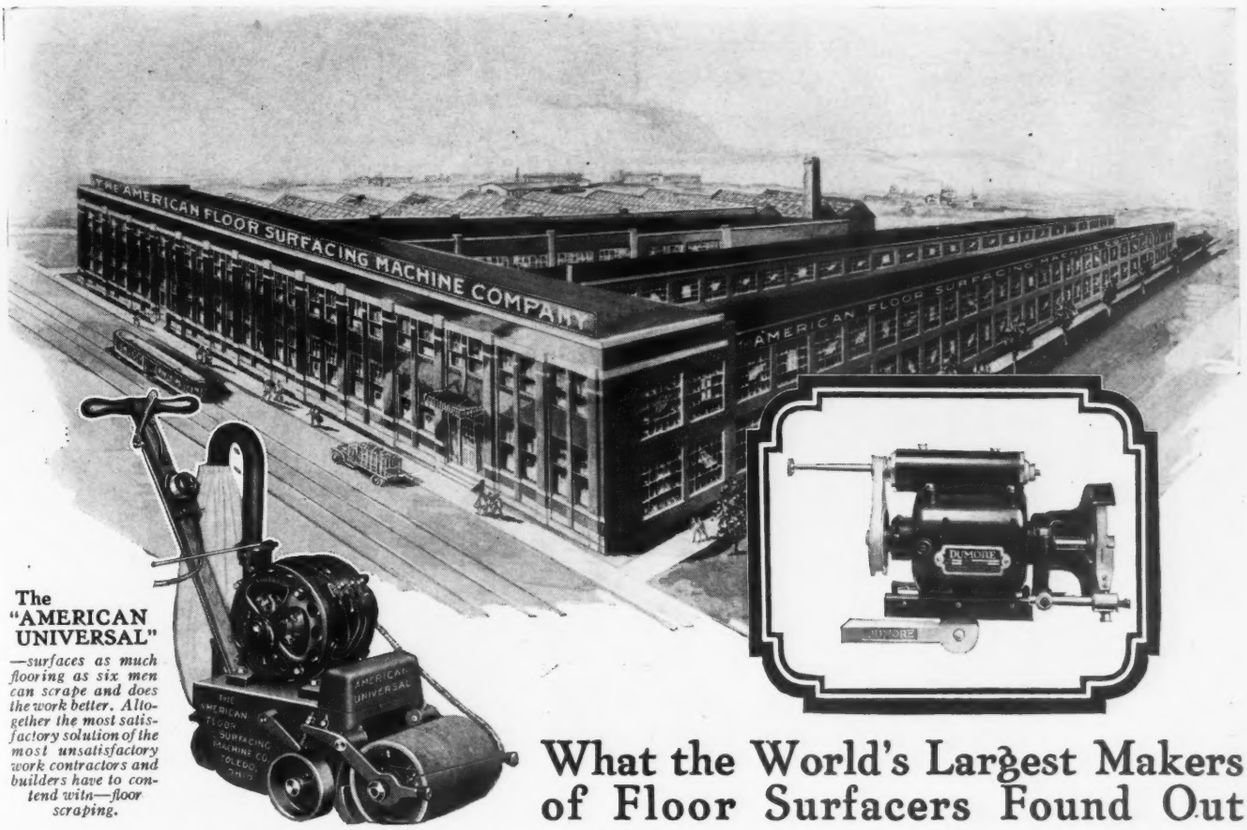
No. 4 Multiple

Two-Way Horizontal With Vertical Head



Two-Way Horizontal





The "AMERICAN UNIVERSAL"

—surfaces as much flooring as six men can scrape and does the work better. Altogether the most satisfactory solution of the most unsatisfactory work contractors and builders have to contend with—floor scraping.

What the World's Largest Makers of Floor Surfacers Found Out

IN the production of American Universal Floor Surfacers—an appliance where dependability and smooth operation are prime requisites—a vast amount of close limit grinding work has to be done. To find a grinder that would meet every exacting requirement, one that would give consistent, economical service for a long period of time—that was the problem that confronted the manufacturers of this labor saving machine.

To solve this problem, once and for all, the American Floor Surfacing Machinery Co., determined to satisfy itself concerning the relative advantages of the various makes of grinders available. Exhaustive tests were conducted—accurate performance records kept. Grinder after grinder was put through its paces.

That a Dumore No. 2-AG stood head and shoulders above the rest in every test is a splendid tribute to the efficiency of these famous high speed grinders. That they were finally selected by this great Toledo concern as standard tool room equipment is a fact in which we take legitimate pride. That this internationally known manufacturer should voluntarily tell us that they knew of no other grinder which equaled a Dumore, is something of which we are more than proud.

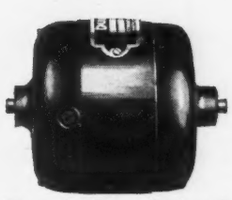
You, too, will voice this same opinion, once you know what these sturdy tools can do in your tool room or plant. The handy coupon below will bring complete information as to their advantages and applications. Your name and address on the dotted lines, please—NOW!

WISCONSIN ELECTRIC COMPANY

25 Sixteenth Street · Racine, Wisconsin

DUMORE HIGH SPEED GRINDERS

For the manufacturer who uses small motors for special requirements, we have available a complete line of fractional h. p. units ranging from 1/40 to 1/4 h. p. Of proven ability for a wide variety of power applications, DUMORE motors might be exactly the power unit you require for that specialty or appliance you may be making. Let us co-operate with you in the building of a better product. No obligation. Write.



Type A-Motor, Stripped

Wisconsin Electric Co., 25 16th St., Racine, Wis.

☐ Send new catalog and other literature describing DUMORE grinders and their uses.

☐ Also information on stripped Fractional H. P. Motors.

Name.....

Address.....

City..... State.....

Why Won't It Work?

NEARLY solved but not quite—is what the inventor seeking perpetual motion invariably finds because *Friction* is one of the elements which baffles him! Metal grinds against metal, bearings must be constantly oiled and yet—wear is ever present making the dream of unlimited power impossible!

As you look into your plant wheels are whirling and the scene of activity makes it appear that maximum production is being secured. But, just as friction makes perpetual motion impossible, so plain bearing transmission equipment is taking a large portion of your power from productive work—through friction.

Skayef Self-Aligning Ball Bearing Hangers practically eliminate friction and reduce high lubricant and maintenance costs. They remove the unseen hand holding back your plant from operating at its highest efficiency. Our engineers will show you why they pay for themselves within two years time.

For Nearest Distributor See MacRae's Blue Book

1167

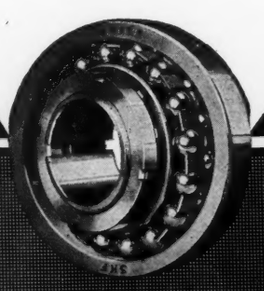
SKAYEF
—the 4-Saving Hanger

1st Saving Skayef Hangers save from 50 per cent upward of the energy which plain bearings consume in friction. This means a saving of 15 to 35 per cent of your power cost.

2nd Saving Considerable time is saved by eliminating shutdowns for replacing or adjusting bearings; forced idleness of machines and men is a cost-factor too big to be ignored.

3rd Saving Lubricant consumption reduced 60 to 80 per cent as compared with plain bearing hangers. Lubricant required only at infrequent intervals and it cannot leak out and ruin belts or product.

4th Saving There is no discernible wear of the hard steel balls and races and absolutely no shaft wear. Dust and grit cannot enter the bearings and Skayef self-aligning ball-bearings have the exclusive inherent ability of compensating automatically for shaft deflections.



SKAYEF
Self-Aligning Ball-Bearing
HANGERS

Made Under **SKF** *Supervision*

THE SKAYEF BALL BEARING COMPANY . . . . 165 Broadway, New York City

LANDIS TRADE MARK

A Big Success in Canada

Big business comes to a decision only after a close study of figures and facts. Therefore when big concerns like the Crane Company of Chicago, choose Landis Pipe Threading and Cutting equipment for many of their plants and branches, there must be very definite reasons behind that choice.

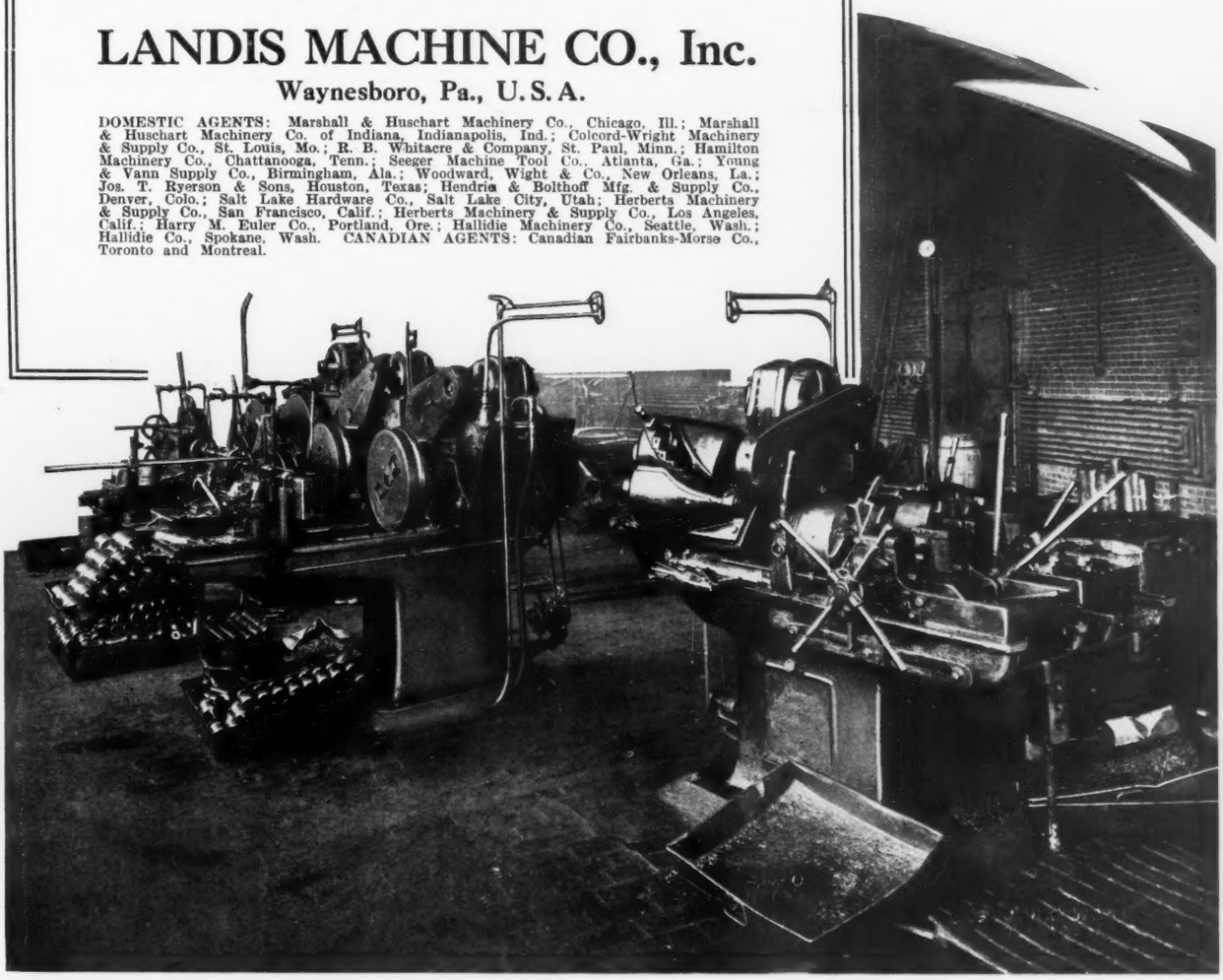
This photo shows a typical Landis installation of Pipe Threading and Cutting Machines in the Crane Canadian plant in Montreal, from which place word comes of the big success of these machines—in unusually excellent quality and quantity of thread production and low upkeep costs.

Nothing could be safer than to follow the example of big, successful concerns when buying your pipe threading and cutting equipment.

LANDIS MACHINE CO., Inc.

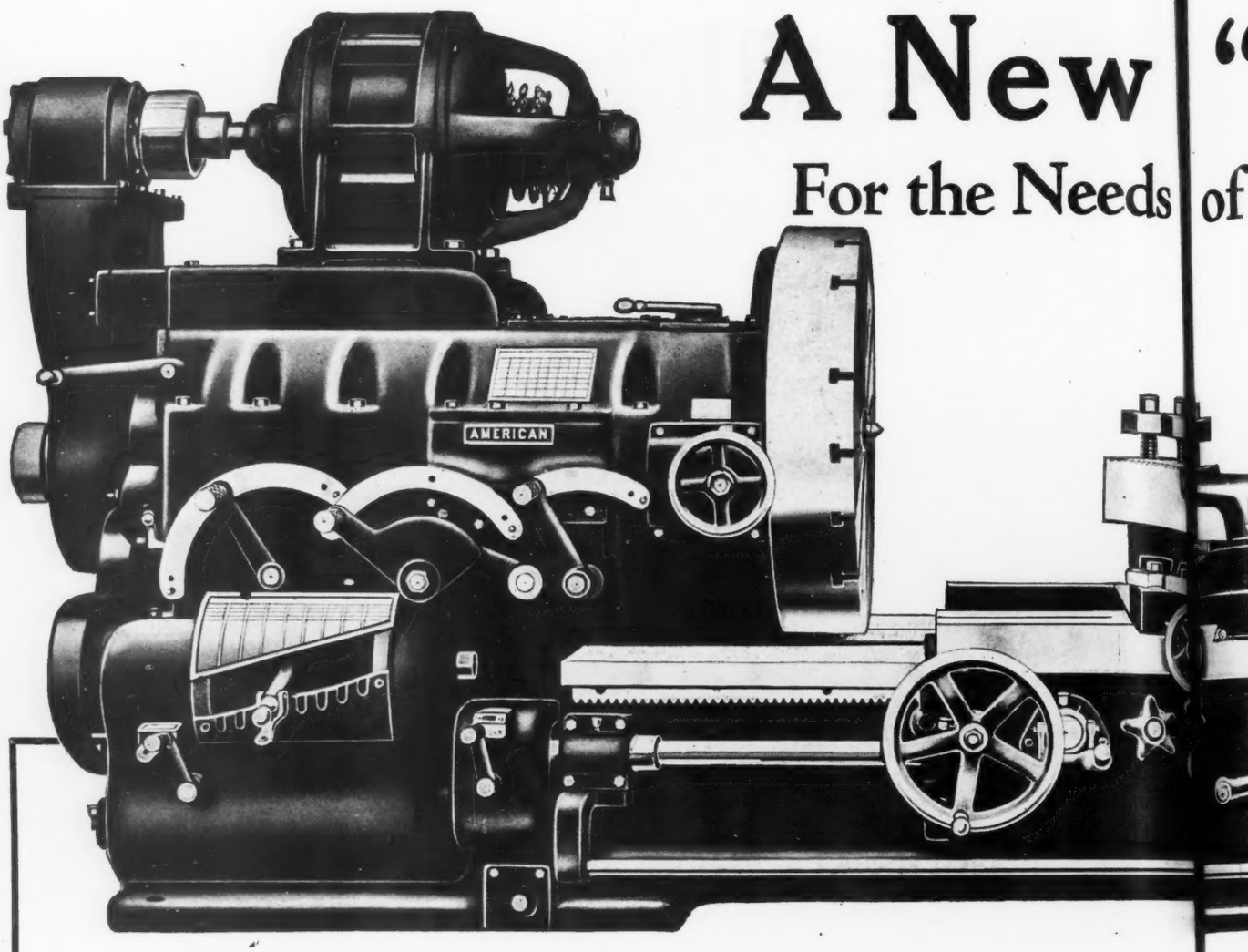
Waynesboro, Pa., U.S.A.

DOMESTIC AGENTS: Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Co. of Indiana, Indianapolis, Ind.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; R. B. Whitacre & Company, St. Paul, Minn.; Hamilton Machinery Co., Chattanooga, Tenn.; Seeger Machine Tool Co., Atlanta, Ga.; Young & Vann Supply Co., Birmingham, Ala.; Woodward, Wight & Co., New Orleans, La.; Jos. T. Ryerson & Sons, Houston, Texas; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Salt Lake Hardware Co., Salt Lake City, Utah; Herberts Machinery & Supply Co., San Francisco, Calif.; Herberts Machinery & Supply Co., Los Angeles, Calif.; Harry M. Euler Co., Portland, Ore.; Hallidie Machinery Co., Seattle, Wash.; Hallidie Co., Spokane, Wash. CANADIAN AGENTS: Canadian Fairbanks-Morse Co., Toronto and Montreal.



A New "

For the Needs of



Shop practice is making such rapid strides forward that machinery which takes ample care of your work today may be insufficient for the work of tomorrow. With this in mind we have developed the *new model*

"American" 42" Super-Productive Lathe

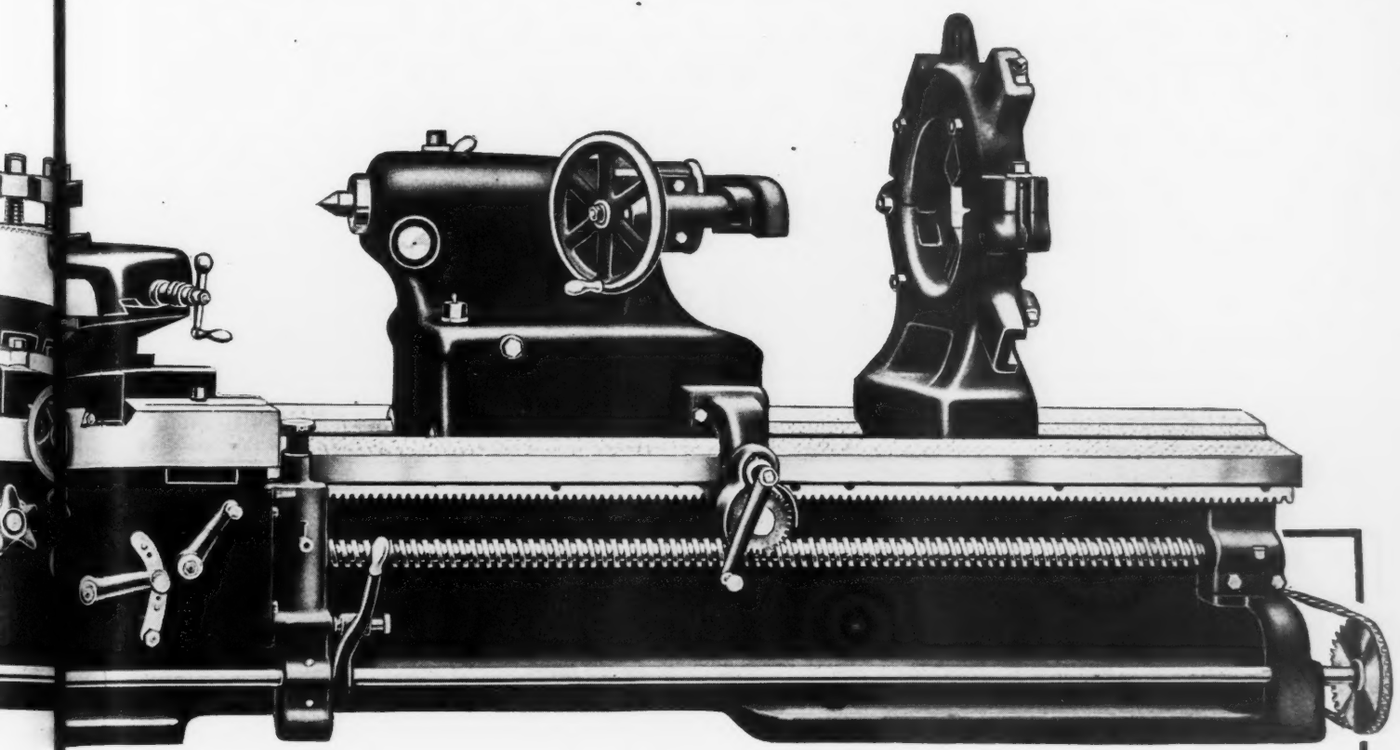
for all the needs of today and sufficiently in advance of present day requirements as to insure adequate capacity for future demands.

The name "American" on a lathe has been and is sufficient recommendation for the most exacting user. Back of this reputation are years of lathe development, fine lathe building and the vast resources of The American Tool Works Company. These have been employed to the fullest extent to make this new machine *a super lathe*—the last word in modern production machines of this type. A machine of this character, tagged with the "American" name plate, cannot fail to arouse interest in the possibilities it represents.

LATHES — AMERICAN — PLANERS

"American" Lathe

of Today—For the Demands of the Future



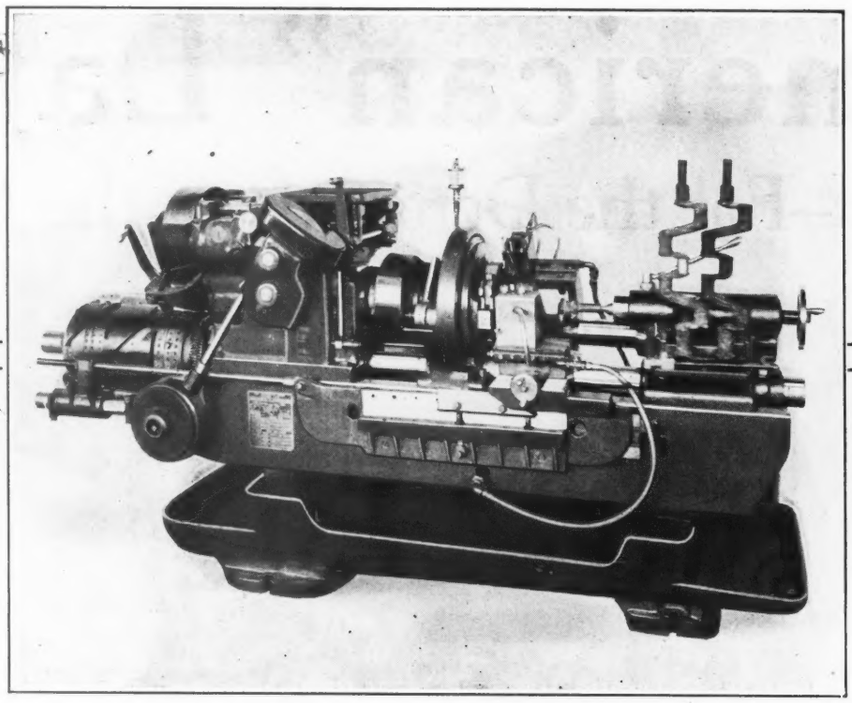
Mention of a few of the outstanding advantages of this machine should be urge enough for anyone to send for the booklet describing this new machine.

18 Speed Geared Headstock—belt or motor drive. 12 out of 18 spindle speeds secured through internal gear face plate drive—making it possible at a speed of 32½ R.P.M. to turn 6″ diameters or larger at a 50′ per minute cutting speed. Over three times the cutting speed of the average lathe on the internal gear drive. All gears in head, including triple gear and face plate pinion, are high carbon chrome manganese steel, heat-treated and, excepting large face plate internal gear, hardened. Will you send for the Booklet?

THE AMERICAN TOOL WORKS COMPANY

CINCINNATI U. S. A.

SHAPERS — AMERICAN — RADIALS



One minute

How do you turn the center bearing on your crankshafts? Here's how it is done with the *Fay Automatic Lathe*, from the rough forging in a single operation, floor to floor in 1 minute.

The sketch, opposite, illustrates the use of special quick-acting, automatic compensating chuck for gripping and supporting crankshaft by throw adjacent to center bearing, also large steady rest for same, special spring center in the headstock, special type of gage block for locating crankshaft endwise in machine, so as to divide the stock equally between the two throws adjacent to the center bearing, and special type of tools employed.

The *Fay Automatic* is built in four types covering a wide range of general production.

Fay Automatic Lathe

AGENTS

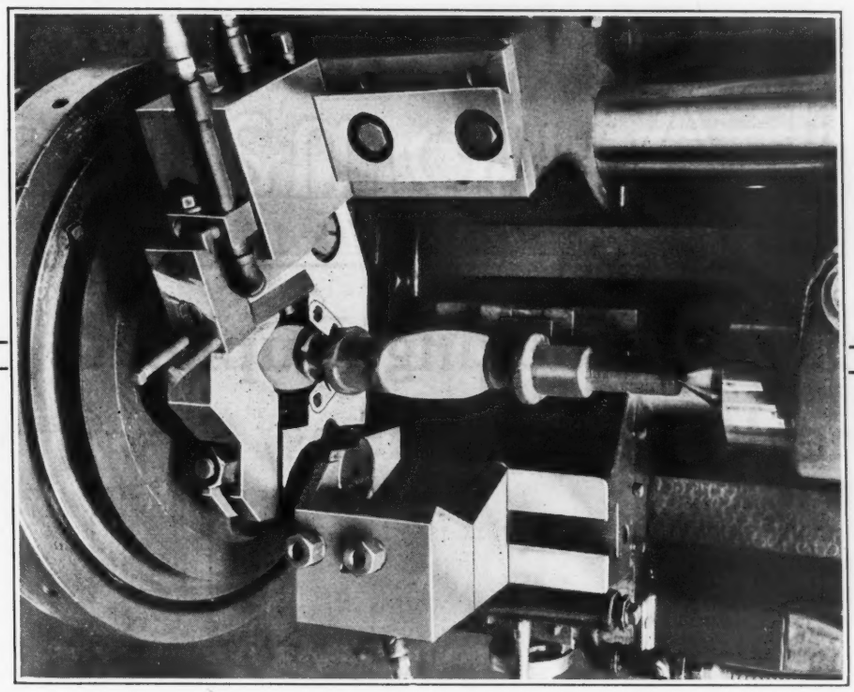
Japan, Korea, Manchuria, Formosa
Mitsui Co., Ltd., Tokio

France, Spain and Belgium—F. Auberty & Co.
182 Rue Lafayette, Paris

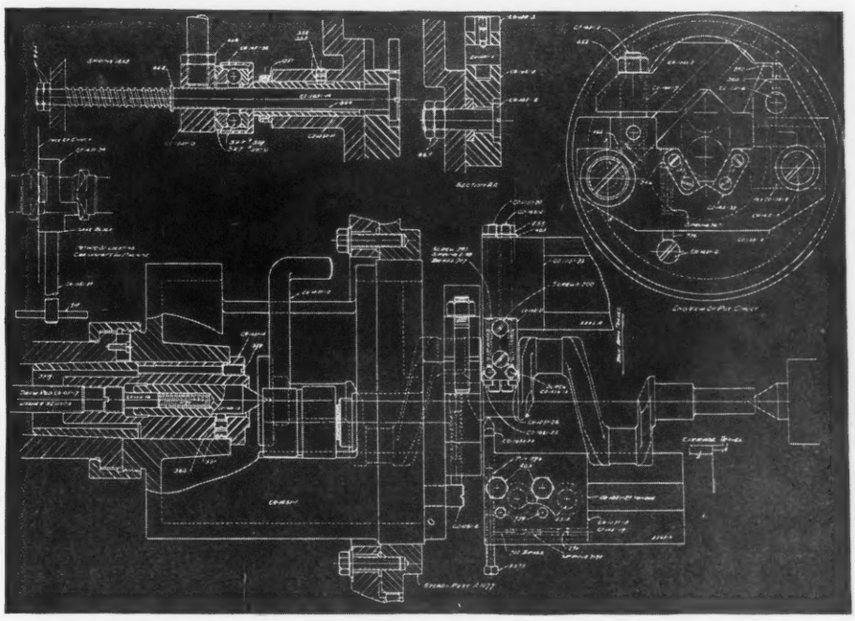
Australasia—McPherson, Ptd., Ltd.
554 Collins St., Melbourne

JONES & LAMSON
SPRINGFIELD,

BRANCH OFFICE: 503 Market Street, San Francisco, California.



floor to floor



MACHINE COMPANY

VERMONT, U. S. A.

BRANCH OFFICE: 9-10 Water Lane, Queen Victoria St., London, England.

AGENTS

Holland—Spliethoff, Beeuwkes & Co.
Luevehaven, Wz., 159 Rotterdam
Sweden—A. Bol. Oscar Lindbom
Stockholm—Post Box 420
Italy—Henry Coe & Clerici, Milano.

P & J Automatics

Automatically Producing Duplicate Parts in the Railroad Shops

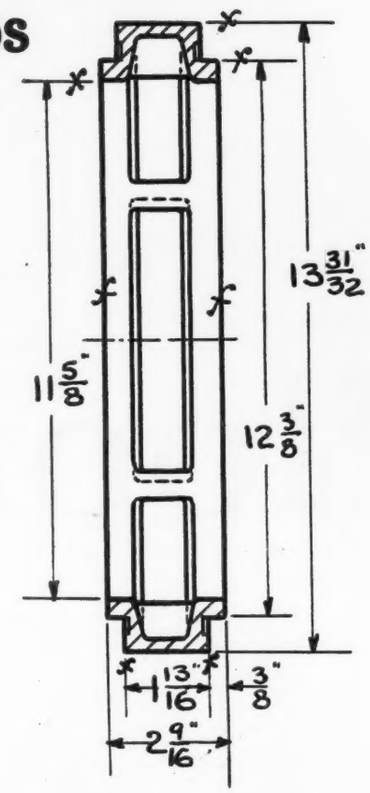
The machining of Bull Rings as shown in drawing is a typical Potter & Johnston Automatic job.

The material is Gun Iron and two operations required to finish the piece.

In the first operation, the subject is gripped on the outside diameter and is Rough and Finished turned, bored, faced and recessed.

In the second operation, the subject is centralized by the bore, held in a finger chuck and Rough and Finished turned, faced and recessed.

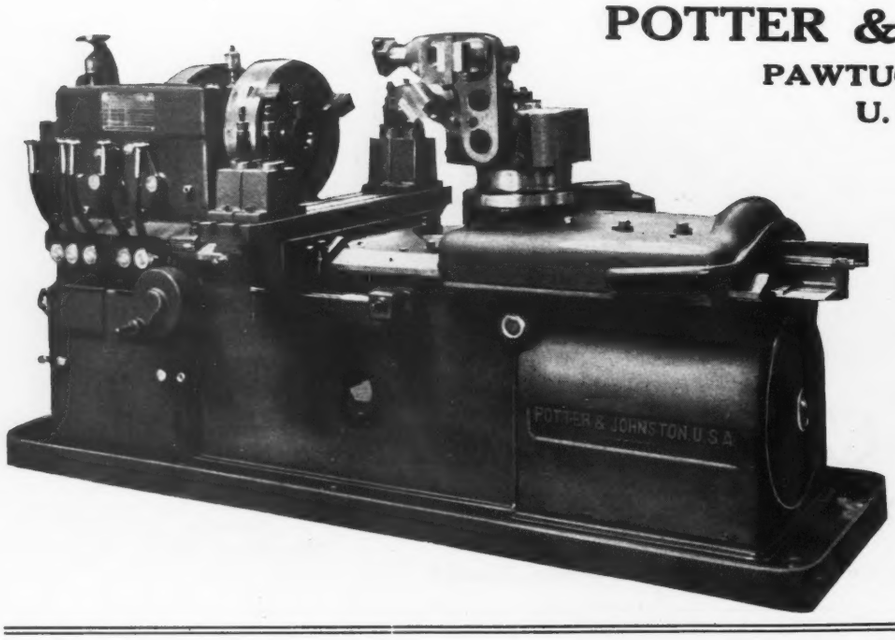
On work of this character ONE MAN ATTENDS TO A BATTERY OF P. & J.'s.



Does this hold some significance for you?

Isn't it worth while to get the Potter & Johnston catalog and find out what P. & J. can do to help your production?

Our Engineers will gladly offer suggestions and a copy of the catalog will start forward to you the day we receive your postcard.



POTTER & JOHNSTON
PAWTUCKET, R. I.
U. S. A.

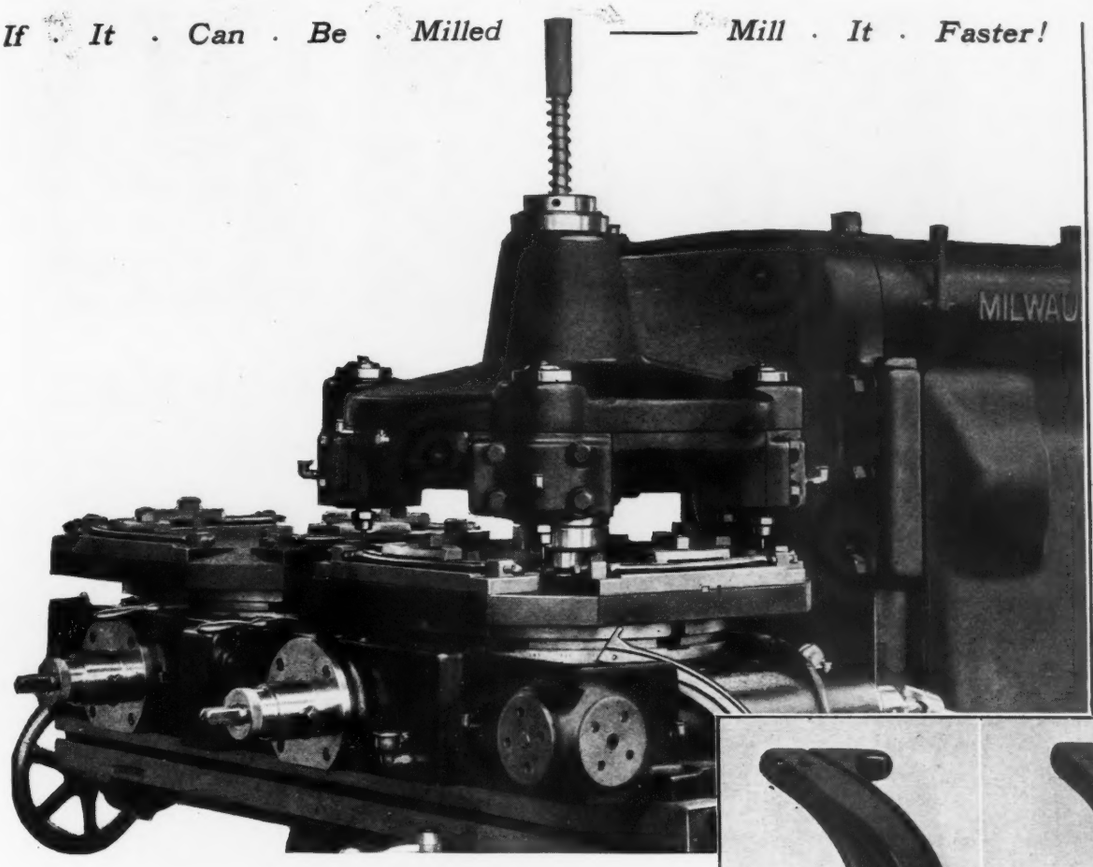
Domestic Offices:

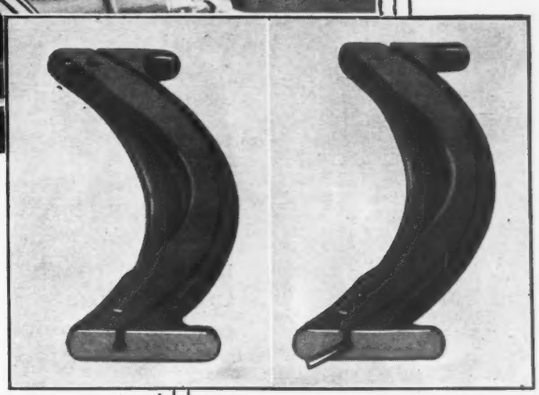
New York Office—Hudson Terminal Building, 50 Church Street. Walter H. Foster, Manager. Detroit Office—The Potter & Johnston Agency Company, 535 Bates Street. Chicago Office, 3057 Eastwood Avenue, Leslie J. Orr, Manager. Pacific Coast Office—Wesley Terrace Hotel, Los Angeles, Cal. Charles H. Shaw, Manager. Canadian Office—Arthur Jackson, 177 Roxborough Street, East, Toronto.

Foreign Representatives:

L. J. Colomb, 68 Avenue de la Grande Armee, Paris, France. Representative for France, Belgium, Switzerland, Spain and Portugal. Charles Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Ercole Vaghi, Corso Porta Nuova, 34 Milan, Italy. Rylander & Asplund, Stockholm, Sweden. Yamatake Company, No. 1 Yuracucho, Ichone, Kojimachi-ku, Tokyo, Japan.

If . It . Can . Be . Milled —— Mill . It . Faster!





Ball Milling
with .096" dia. cutters
On a K & T Layout

Ball milling of radial grooves with four tiny cutters .096" dia. rotating 2500 R. P. M., is a delicate job for a two-ton milling machine, but the Corona Typewriter Company found that this layout used on a standard Kearney & Trecker Machine gave greater production and closer accuracy than a special machine.

Not only was the initial cost lower, but the same head was also used for the previous operation of trepanning the radial grooves in the same type bar segments.

Two independently controlled rotary tables are mounted on the table of the milling machine. The operator loads one fixture while the other is in the cut.

The clamping devices are so arranged that when the four segments on one fixture are milled, the other fixture can be moved into working position without lowering the milling machine table.

Send for K & T Production Service Book and Layout Data, or, without obligation, send us blue prints of parts that you want milled at lower cost.

KEARNEY & TRECKER
CORPORATION

Manufacturers of Milwaukee Milling Machines

Send the Coupon

Send the coupon below for our Production Service Book and additional data on K & T Layouts. Each one of them has been especially developed by our Production Service Department to meet some difficult milling problem of production or cost. They will show you how others have profited by using our Production Service and how K & T Layouts will meet your needs on large or small production.

KEARNEY & TRECKER
MILWAUKEE MILLING MACHINES

Kearney & Trecker Corporation
Milwaukee, Wisconsin

Please send me your Production Book and K & T Layout Data Sheets. M-8-24

Name _____

Firm Name _____

Firm Address _____

Save Expense of Changing Your Equipment

It costs money to change your equipment to use larger than regular drill shanks, besides, there is no reason to do so.

You know the modern drill can't work up to its capacity when driven by the same size and kind of shank adopted years ago. Your broken and twisted tangs when stepping up the speed and feed proved its weakness.

Is strength in an automobile secured by larger and heavier parts?—no, cars are getting **lighter** in **weight** but better able to stand strains by more intelligent selection of the proper material for the task put before it.

So we were the pioneers in adopting S.A.E. 3135 Chrome Nickel Steel (Heat-treated) for our tool shanks. It has more than double the strength of the ordinary material (170,000 compared with 80,000 pounds to the square inch).

Other drill makers are asking you to take oversize shanks. Why don't they use better material and save you the cost of changing your equipment.

"Detroit" Tools with this **modern shank** cost you no more and are guaranteed against twisting and breaking.

Try Them Now for Maximum Results.

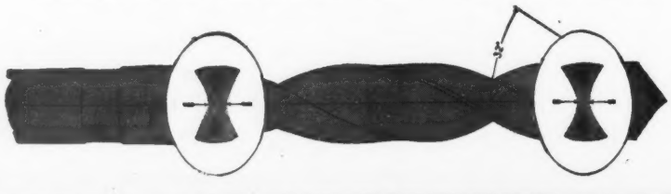
Detroit Twist Drill Company, Detroit, Michigan

2108 WEST FORT STREET

45 Warren Street, New York **101 Marietta Bldg., Atlanta**

Canadian Detroit Twist Drill Co., Limited, Walkersville, Ontario

The wide flute insures ample chip clearance for deep drilling

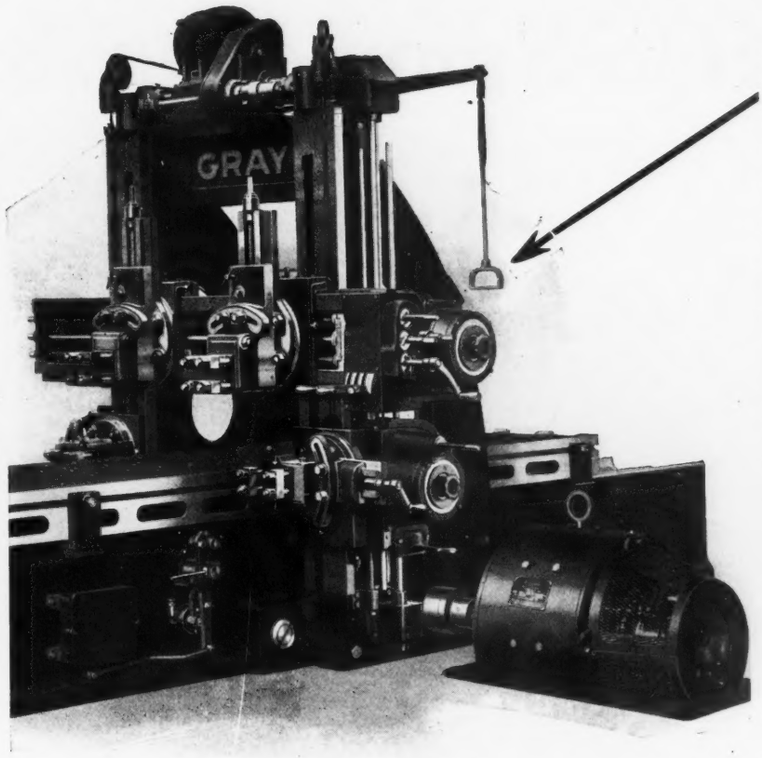


Double-D hot-rolled drills now available in sizes from ¼" to 1⅝"

(55)

DETROIT DOUBLE-D ROLLED DRILLS

A PUSH—AND IT'S THERE



To elevate the rail you push up the stirrup; to lower the rail you pull down the stirrup. The control is so perfect that the rail can be set to a line.

The stirrup is locked in the off position, when not in use. It hangs from a universal joint so that when lowering the rail the operator stands out in front where he can see his work and his tools.

This means that he will set his rail close to his work; reduce the reach; take heavier cuts; and get work free from chatter.

The Gray Rail Setter is but one of the fourteen features that insure increased production from

Gray Planers

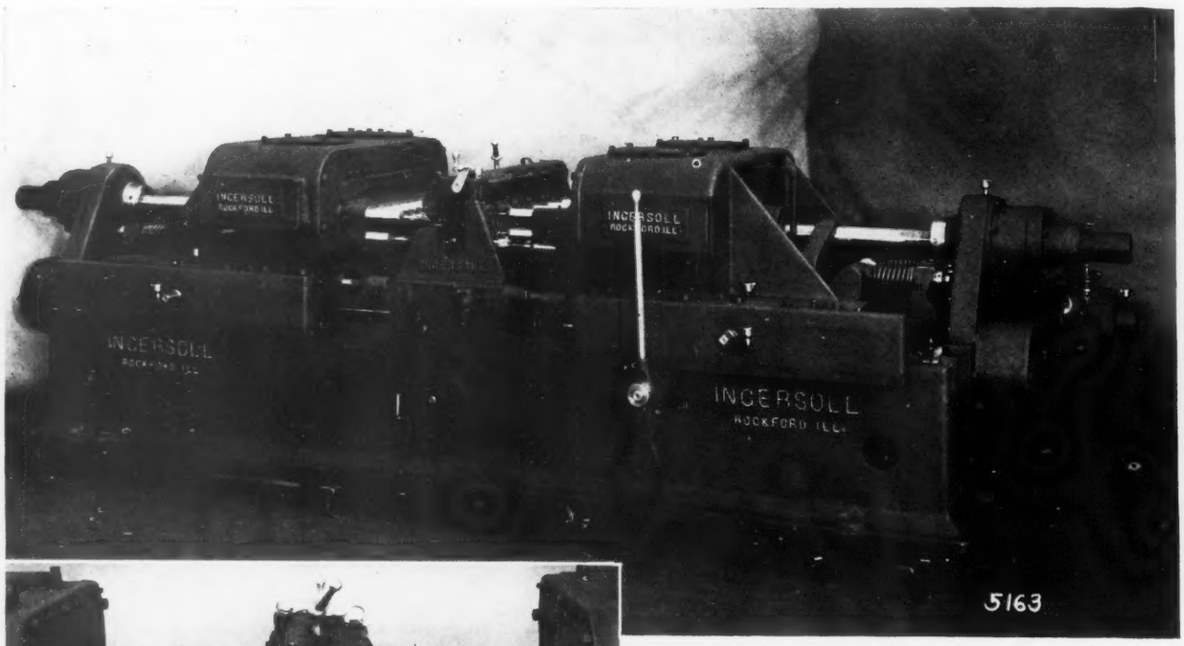
1. Single shift rapid power traverse for side-heads and rail-heads. Patented.
2. Cantslip Dial Feed; positive and instantly set. Patented.
3. Rail setter; you set the rail from the operating position. Patented.
4. Rail-lock; turning one crank locks rail to inside of housings. Patented.
5. Gray-geared for power and enduring smoothness of motion. A new type of gearing. Patented.
6. All driving gears run in oil.
7. Double-length bed. Table never overhangs.
8. Gray forced lubrication to V's with filtered oil. Patented.
9. Center-wall box table; prevents springing.
10. Forced lubrication of driving shaft bearings.
11. Oil pressure relief valve; insures uniform oiling at all speeds. Patented.
12. Centralized lubrication of other parts.
13. Complete centralized control.
14. Gray safety clutches; make the planer fool-proof.

THE G. A. GRAY CO.

Cincinnati, Ohio

INGERSOLL

Special Multi-Spindle Drills



Showing the arrangement of the spindles and the fixture.

An Ingersoll Two-way 50 Spindle Special Drilling Machine

This Ingersoll two-way fifty-spindle Special Drilling Machine is arranged for drilling fifty holes in the two opposite sides of the head for a six-cylinder motor. It is semi-automatic in operation. The operator loads the fixture and then throws in the feed. The saddles feed forward against a positive stop where they pause a moment and then they quick return to a stop. The production is 40 pieces per hour.

The extremely rugged construction of this machine insures long life and reliable service. The saddles are mounted on compound slides so that they may be run back to change drills. These saddles may be adjusted separately for depth to be drilled. They have a common power feed and quick return and pick-off gears for feed changes. All gears are hardened and run in oil.

We will be glad to furnish you with more detailed information about this tool, which is only one of the many special machines we build.

A stock of standard inserted tooth milling cutters, from which prompt shipment can be made, is carried at Rockford.

We will gladly send you any of the following bulletins:

No. 39—"Ingersoll Continuous Milling Machines,"
No. 40—"Ingersoll Installations of Milling Equipment,"
No. 41—"Ingersoll Drum Type Continuous Milling Machines,"
No. 44—"Ingersoll Milling Cutters."

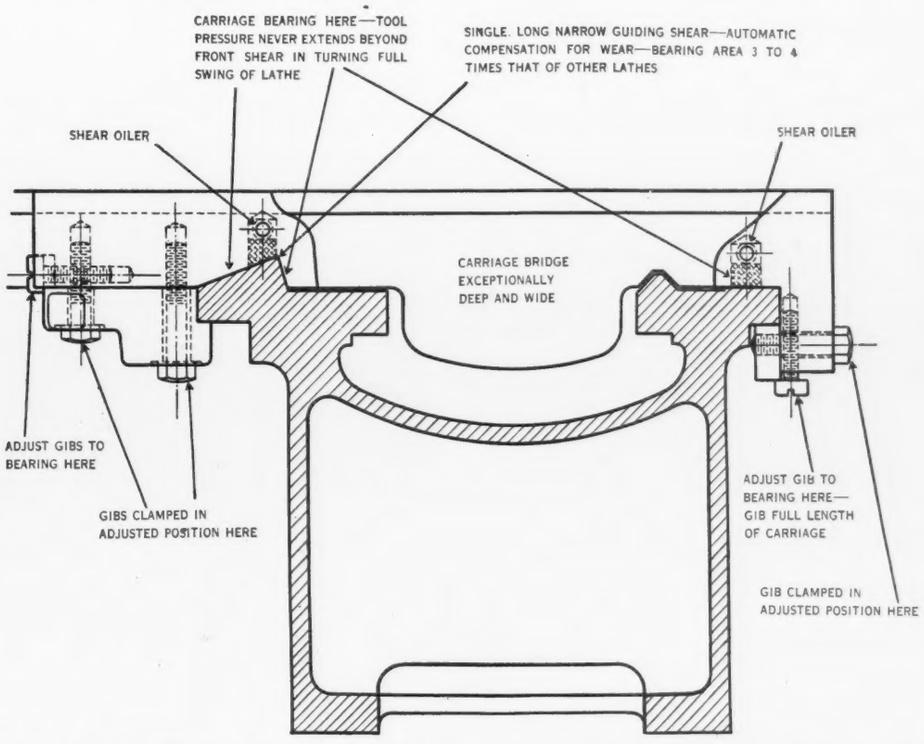
THE INGERSOLL MILLING MACHINE CO.

Milling Machines and Their Equipment

50 Church Street, New York City — ROCKFORD, ILLINOIS — 1457 David Whitney Bldg., Detroit

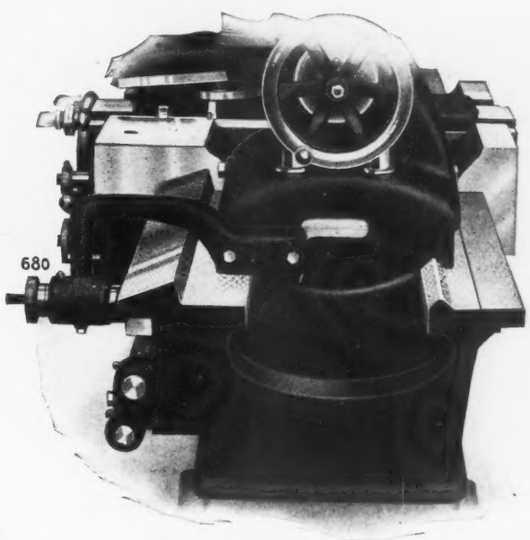
THE LeBLOND HEAVY DUTY BED

with a Scientific Arrangement of the Carriage Gibs


CARRIAGE BEARING HERE—TOOL PRESSURE NEVER EXTENDS BEYOND FRONT SHEAR IN TURNING FULL SWING OF LATHE
SINGLE, LONG NARROW GUIDING SHEAR—AUTOMATIC COMPENSATION FOR WEAR—BEARING AREA 3 TO 4 TIMES THAT OF OTHER LATHES
SHEAR OILER
SHEAR OILER
CARRIAGE BRIDGE EXCEPTIONALLY DEEP AND WIDE
ADJUST GIBS TO BEARING HERE
GIBS CLAMPED IN ADJUSTED POSITION HERE
ADJUST GIB TO BEARING HERE—GIB FULL LENGTH OF CARRIAGE
GIB CLAMPED IN ADJUSTED POSITION HERE

Cross Section Heavy Duty Bed and Carriage on LeBlond 15" Heavy Duty Lathe Showing Disposition of Bearing Surfaces and Arrangement of the Carriage Gibs.

The design of our bed and carriage provides an effective carriage bearing surface several times that found on lathes of other constructions. This large bearing area consists of but three surfaces, on which all wear is automatically compensated for. The effective arrangement of the carriage gibs is a distinct departure from conventional practice.



The R.K. Le Blond Machine Tool Co.

Cincinnati. Ohio.

None but another

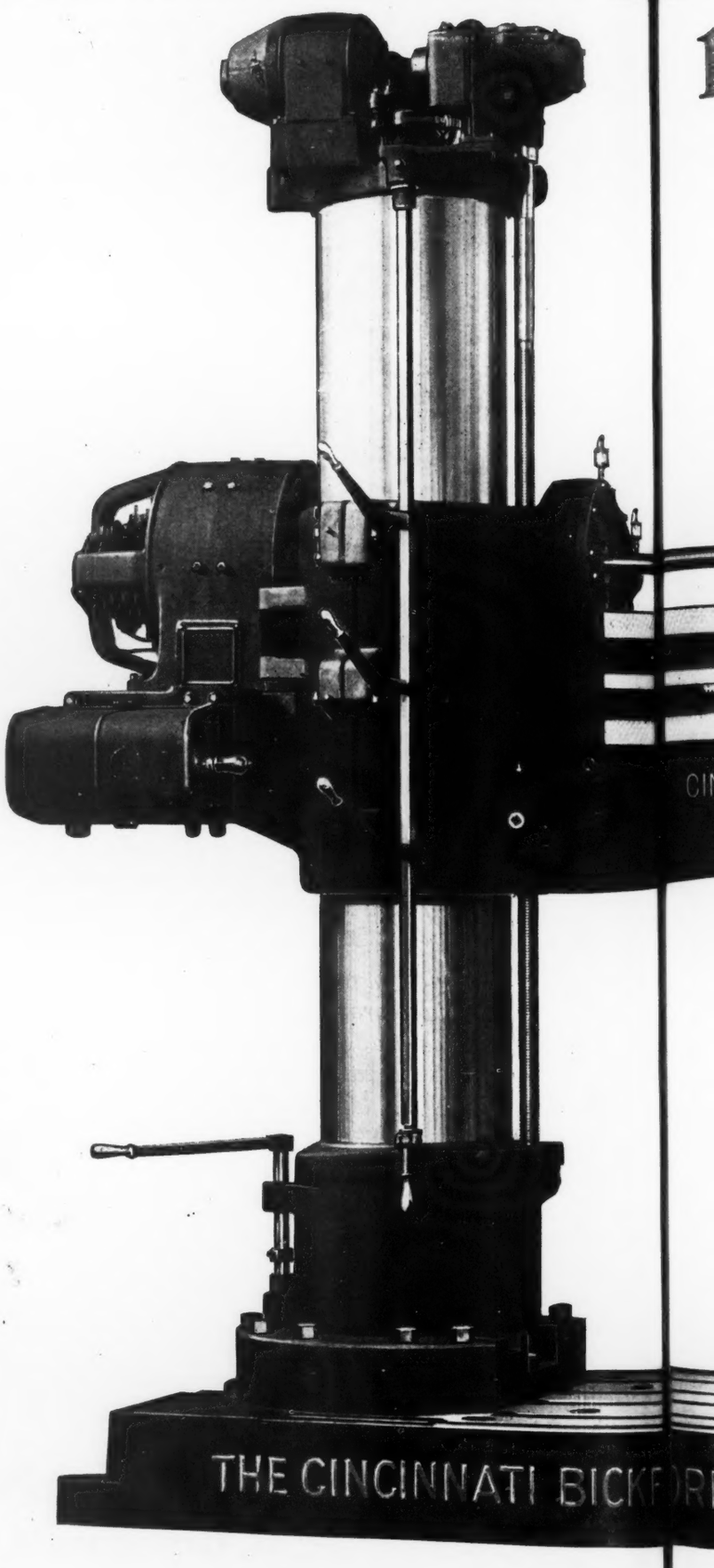
Cincinnati Bickford Master Radial

dares match its prowess against this veritable embodiment of Hercules

It is the finale of 50 years of specialization in the manufacture of DRILLING MACHINERY

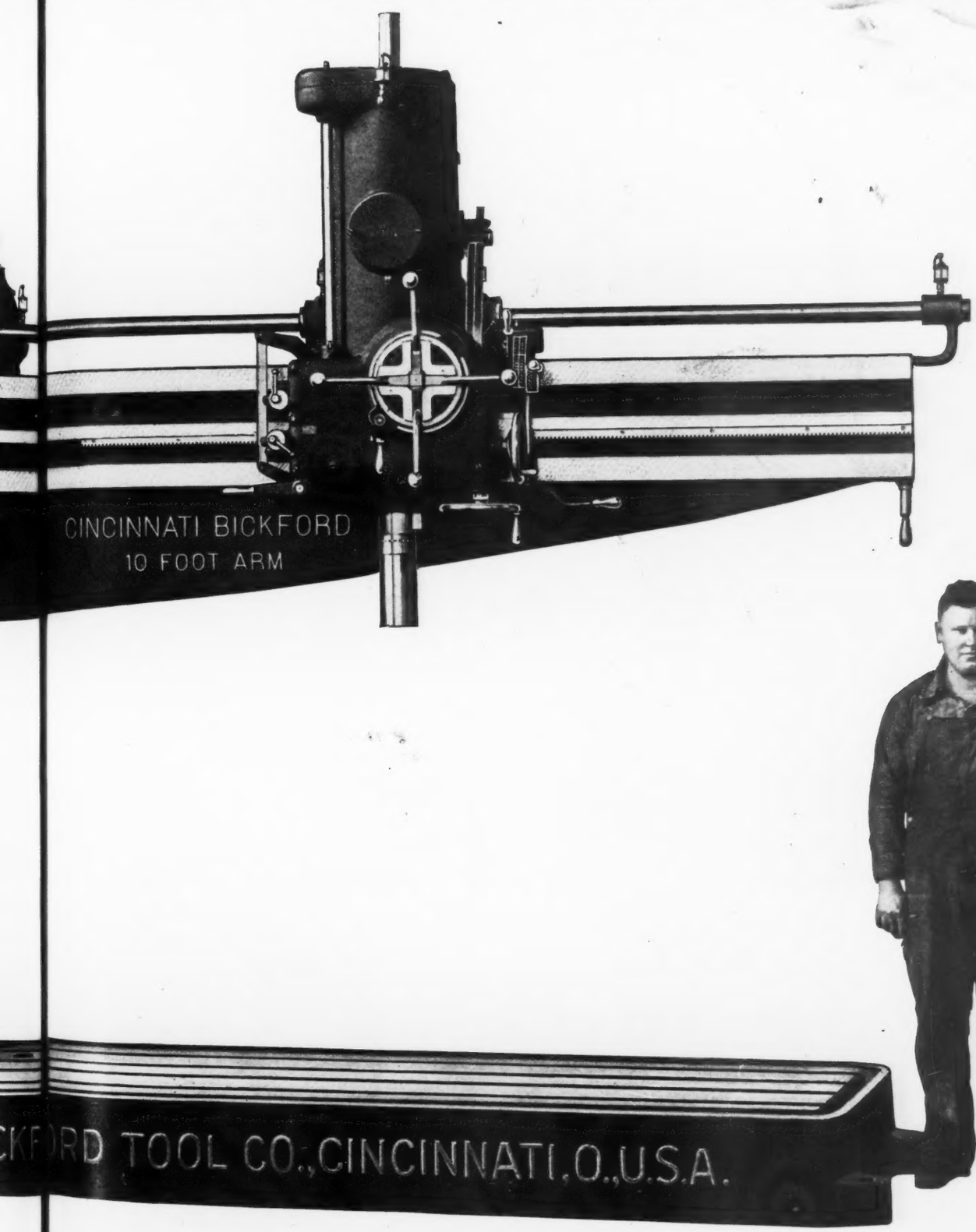
Speeds, number	45
" range	14.8—510 R.P.M.
Feeds, number	10
" range	.008—.040 in.
Diameter of column	22 inches
Depth of base	12 inches
Weight, net	35,000 lbs.

If a better radial can be built, it will be a Cincinnati Bickford

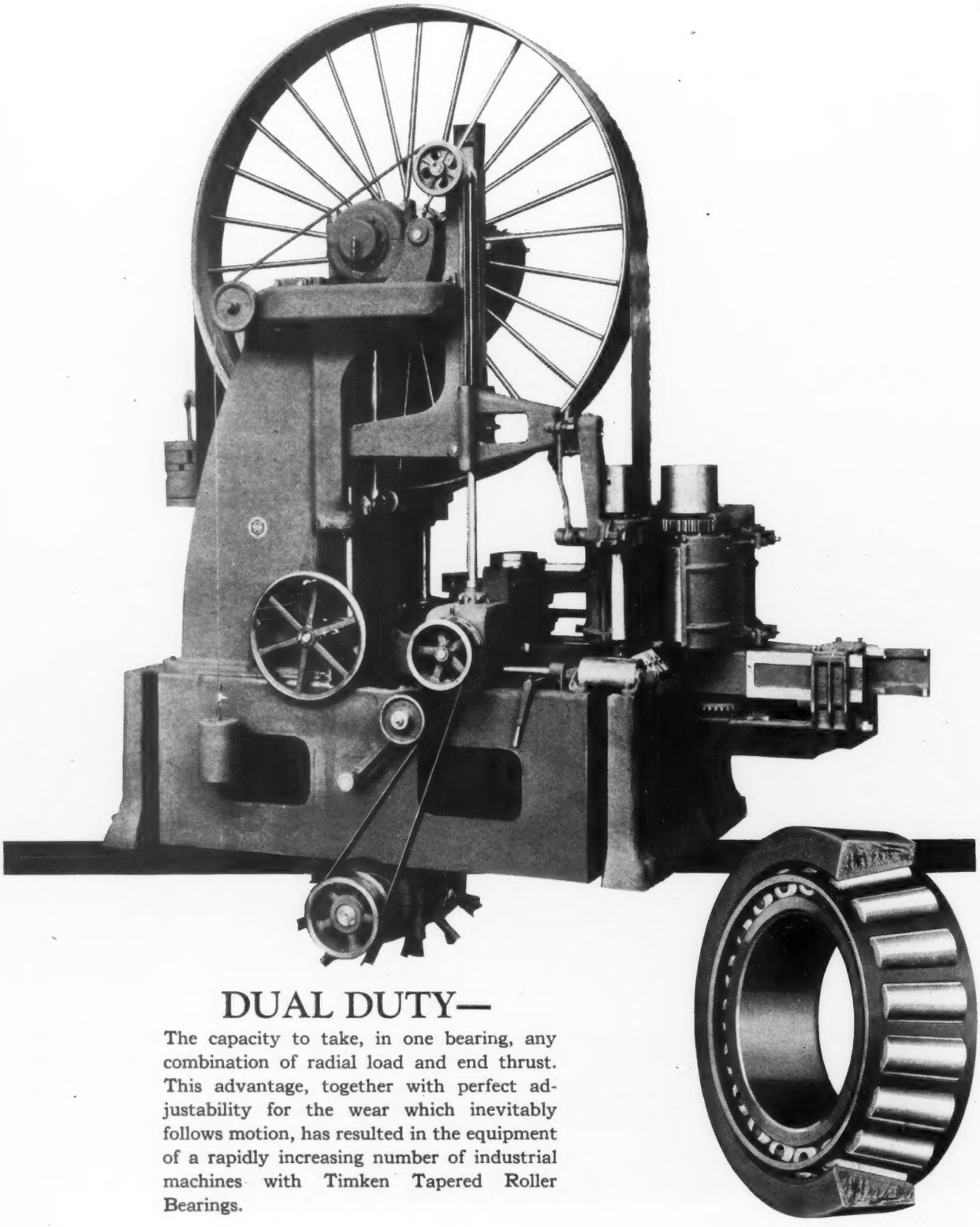


10 FOOT MASTER RADIAL

The Generalissimo of Drilling Machines



A 50% Power Saving



DUAL DUTY—

The capacity to take, in one bearing, any combination of radial load and end thrust. This advantage, together with perfect adjustability for the wear which inevitably follows motion, has resulted in the equipment of a rapidly increasing number of industrial machines with Timken Tapered Roller Bearings.

in the Yates Resaw

The most powerful resaw built—a heavy duty machine for the largest mills is Timken-equipped throughout. Many new production records have been established with the Yates V-7.

The following table demonstrates how Timken Bearings helped in producing these records.

	Horsepower required with Babbitt Bearings	Horsepower required with Timken Bearings	Resultant Saving
Starting	120 H. P.	64 H. P.	56 H. P.
Run Idle	35–40 H. P.	16 H. P.	22 H. P.
	Cutting 12" Hemlock		
Intermittent Service	60 H. P.	25 H. P.	38 H. P.
Constant Service	94 H. P.	35 H. P.	59 H. P.

This initial power saving of 50% becomes a permanent saving due to the proved ability of Timken Bearings to hold shafts and gears in permanent alignment over a period of years. Moreover, continuous, uninterrupted service is assured by the high load-carrying capacity of the Timken Bearing.

The success of these bearings in this application, involving heavy loads and high speeds, is an indication of the ability of Timken engineers to cooperate in improving all types of industrial machinery. Put your problem up to them.

The Timken Roller Bearing Company
Industrial Division
CANTON, OHIO

TIMKEN
Tapered
ROLLER BEARINGS

© 1924, T. R. B. Co.

Making Jaw Forgings

on the

NATIONAL

(ALL STEEL)

Heavy-Pattern Forging Machine

The experienced forge shop man will realize at a glance that this forging is difficult to make.

Forgings requiring splitting operations of this unusual depth can only be satisfactorily made in a machine possessing a rigid grip and excellent slide and die alignment.

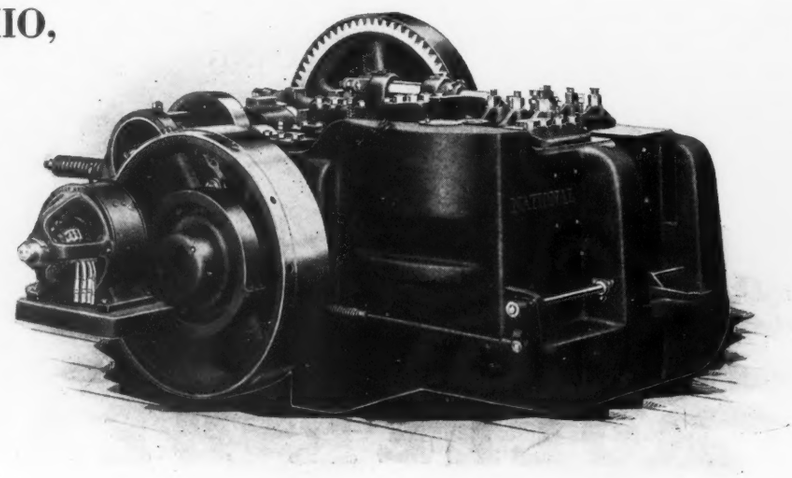
The National Heavy Pattern Forging Machine handles such jobs with ease, due to the great power of the side dies and the means provided for maintaining accurate alignment.

We will appreciate the opportunity of solving your forging problems.

The National Machinery Co.

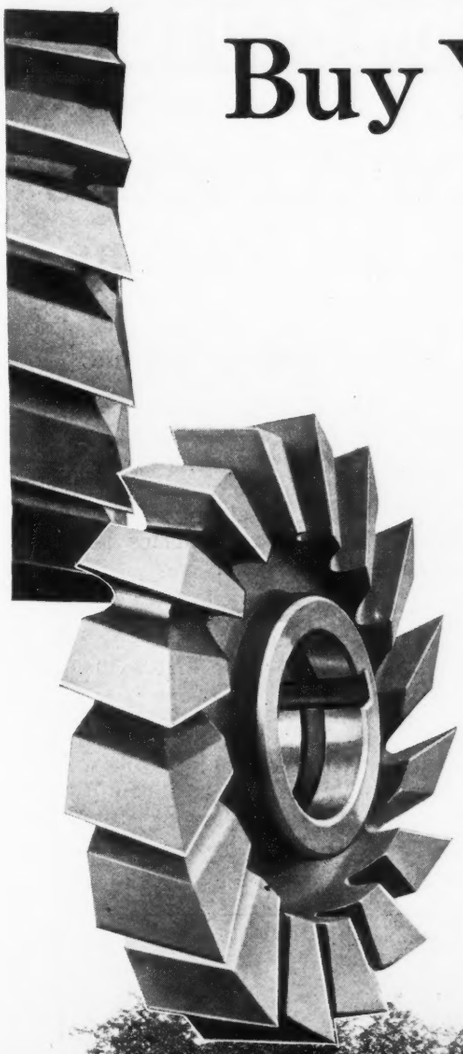
Originators of Modern Bolt, Nut and Forging Machinery

TIFFIN, OHIO,
U. S. A.



ARE YOU RECEIVING NATIONAL FORGING MACHINE TALKS?

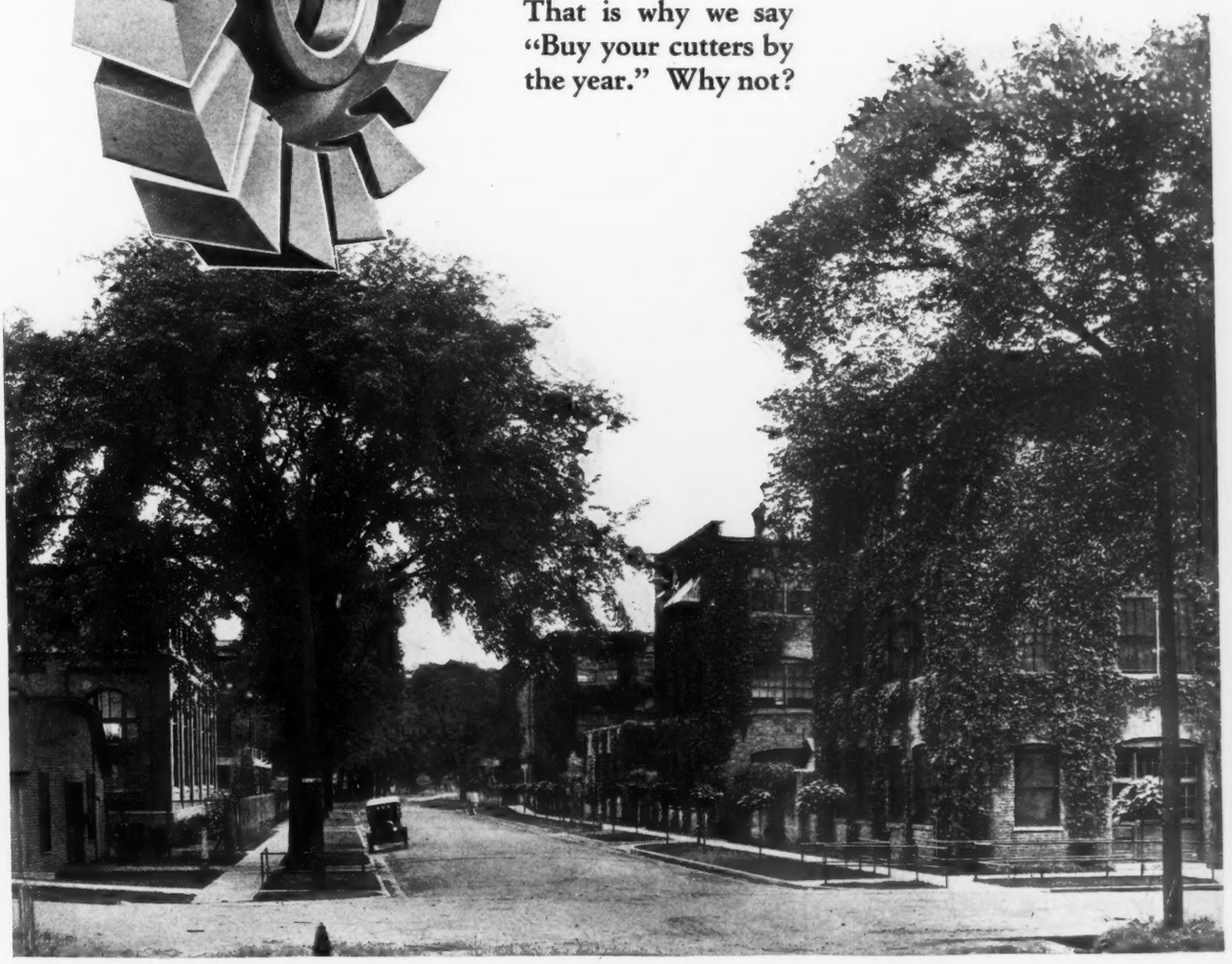
Buy Your Cutters by the Year



We Say—"Buy your cutters by the year" because it requires a considerable period of use to determine the real efficiency of any brand of cutter. A test run between two cutters determines the relative value of those two only, but one birdie doesn't make a summer. Barber-Colman cutters are used in all four seasons and they are made under conditions that insure highest production and longest life between grinds *all the year around.*

Cutters *will* vary a little; ours we aim to have vary *upward* from a high all-year average.

That is why we say "Buy your cutters by the year." Why not?

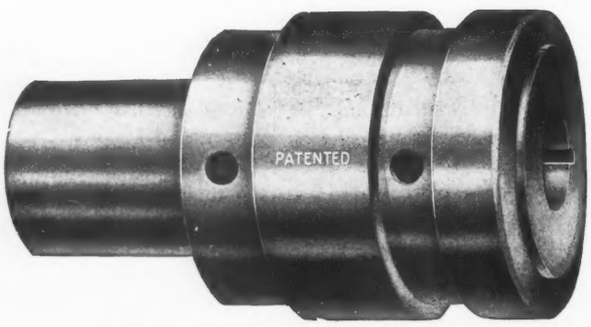


BARBER-COLMAN COMPANY, Rockford, Ill., U. S. A.

THE JOHNSON FRICTION CLUTCH

EIGHT JOHNSON CLUTCHES Used on this Machine

The New Sommer & Adams Multiple Spindle Spline Hobbing Machine



SINGLE CLUTCH EXTERIOR

The drive for the hob spindles and work heads is obtained from a vertical shaft located at the center of the column. This shaft is driven through bevel gears from the drive shaft in the base and carries at its upper end a large bevel gear.

Meshing with this gear are eight bevel pinions, running loosely on shafts which extend radially toward the hob drive of the mechanism.

Each Carlyle Johnson No. 2 Single Clutch is operated by its individual handle to transmit the power from each pinion, and by this means each unit can be started or stopped independently.

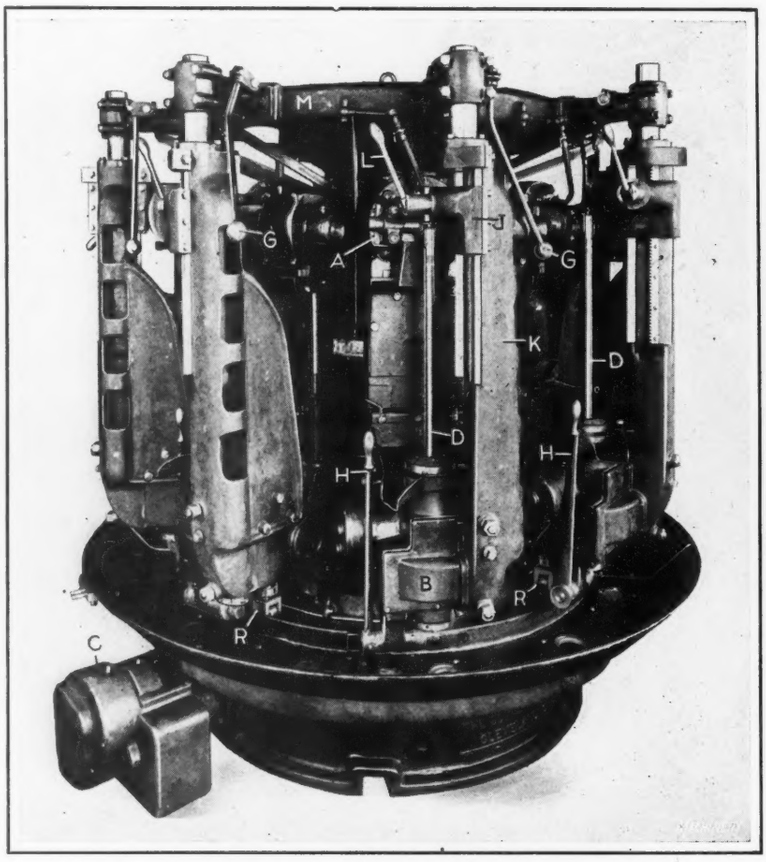
EIGHT Carlyle Johnson Clutches on this splendid new Spline Hobbing Machine! That's what the Sommer & Adams Company think of the Johnson Clutch. Most of the prominent machine builders of the country think the same way.

Candidly speaking, isn't that a whale of an order in clutches for just one machine?

Cuts Costs

The Johnson Clutch cuts down the cost of power transmission and thereby saves money for you. It is very strong; it runs smoothly; it is without clatter or bang; it is a satisfactory, long-life clutch.

Write today for Catalog "A"



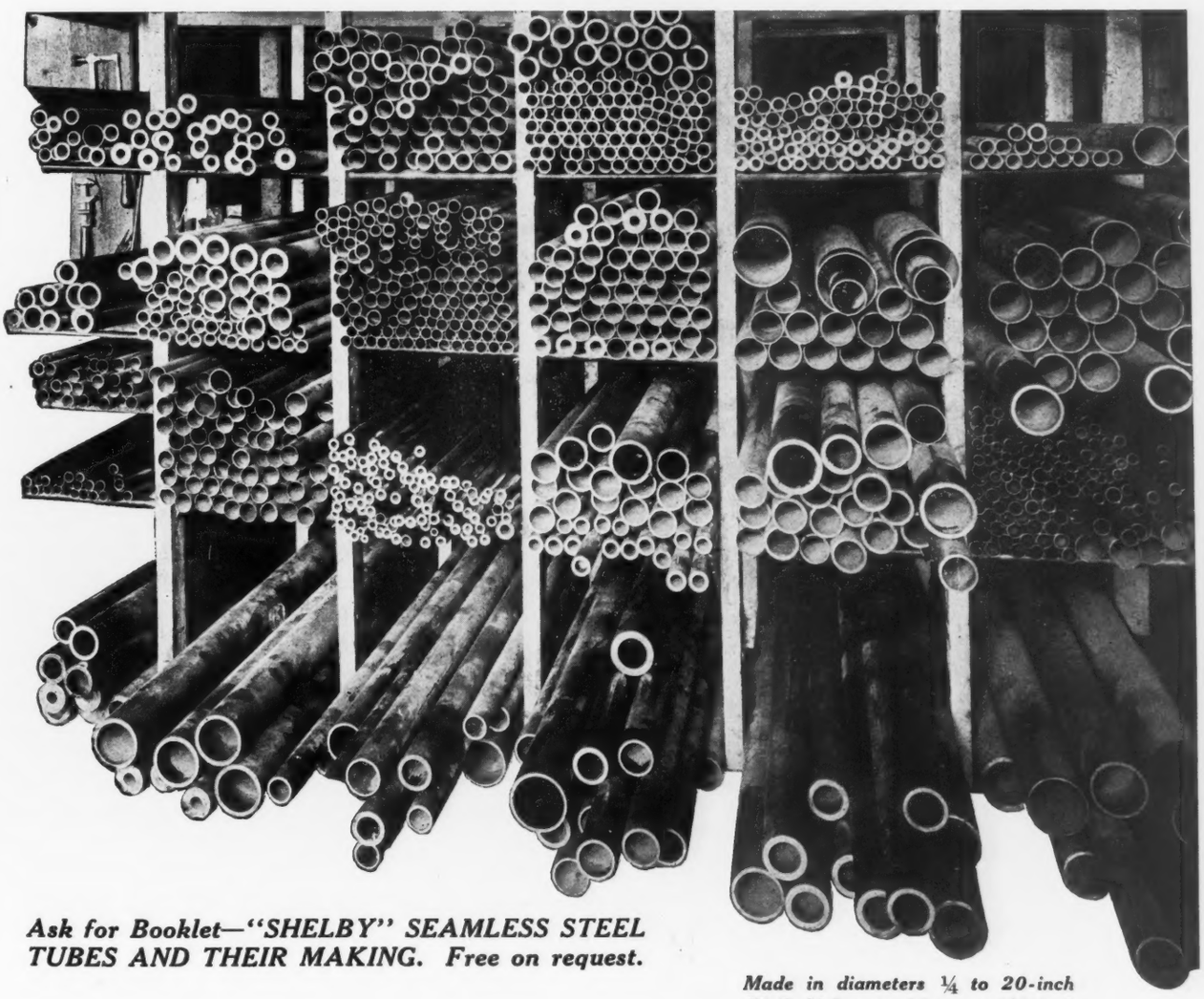
Courtesy: The Sommer & Adams Company, Cleveland, Ohio

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.

For Mechanical Purposes Essentially Tubular, Use

"SHELBY"
SEAMLESS STEEL TUBING

In addition to the numerous sizes and wall thicknesses of round tubing usually carried in stock, "SHELBY" tubing is obtainable in a number of special shapes such as hexagonal, oval, D-shaped, etc., and in special steels and anneals to meet practically any requirement. When used in place of solid stock or forgings "SHELBY" tubing results in appreciable savings of time, tools and labor.



Ask for Booklet—"SHELBY" SEAMLESS STEEL TUBES AND THEIR MAKING. Free on request.

Made in diameters ¼ to 20-inch
Wall-thicknesses 20-ga. to 1½-inch

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

General Sales Offices: Frick Building

DISTRICT SALES OFFICES

Atlanta Boston Chicago Denver Detroit New Orleans New York Salt Lake City Philadelphia Pittsburgh St. Louis St. Paul

PACIFIC COAST REPRESENTATIVES: U. S. Steel Products Company San Francisco Los Angeles Portland Seattle

EXPORT REPRESENTATIVES: U. S. Steel Products Company New York City

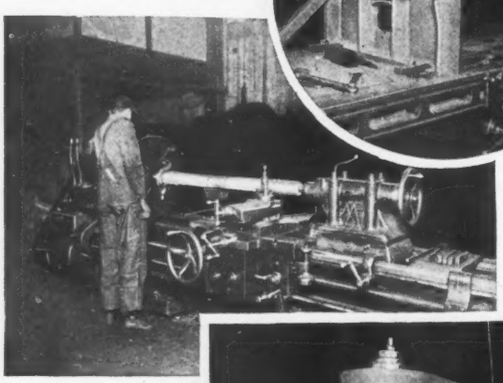
REED-PRENTICE MACHINE TOOLS

PRODUCTS
Lathes
Radial Drills
Becker Millers
Whitcomb Planers
Production Cutters
Special Machinery

WHITCOMB PLANER

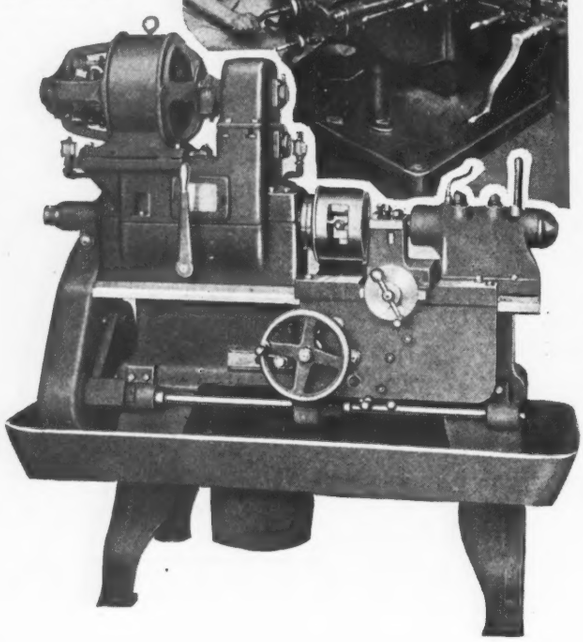
REED-PRENTICE Center Drive Lathe

REED-PRENTICE Geared Head Lathe



BECKER Vertical Miller

REED-PRENTICE Universal Joint Lathe



Production Machines for all kinds of work

Here are some of the Reed-Prentice products: standard machines to handle the ordinary operations that come up in manufacturing practice; special machines developed to meet the needs of big production.

Reed-Prentice Machine Tools make production profitable; big industries buy them because they get results, invariably; because they operate at minimum upkeep and labor cost, and are long-lived machines under every condition of service.

Tell us what operation you wish to perform more economically; we'll show you the Reed-Prentice Machine to make it pay. We'll prove Reed-Prentice efficiency—in advance—or no sale.

REED-PRENTICE COMPANY
MACHINE TOOLS
WORCESTER MASS., U.S.A.

BRANCH OFFICES:
149 Broadway, New York, N. Y.
536 Singer Bldg.
6526 Cass Avenue, Detroit, Mich.
Opposite General Motors Bldg.
549 Washington Blvd., Chicago, Ill.
204 Machinery Hall

Representatives throughout the World

"MORSE"

Carbon and High Speed Drills

are big factors in attaining High Efficiency Results. They are tools that are built up to a Quality Standard above which there is no other

MORSE

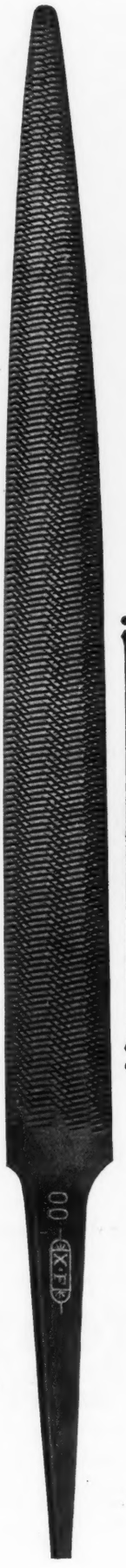
ARBORS
CHUCKS
COUNTERBORES
CUTTERS
DRILLS
GAUGES
GRINDERS
MANDRELS
TAPER PINS
SCREW PLATES
REAMERS
SLITTING SAWS
SOCKETS
SLEEVES
TAPS and DIES
TAP WRENCHES
DIE STOCKS
&
MACHINERY

Try out any of the Tools here listed and you will become a Booster for the "MORSE" BRAND

Made in New Bedford, Used Everywhere

MORSE
TWIST DRILL & MACHINE CO.
NEW BEDFORD, MASS., U.S.A.

MORSE TOOLS ARE SOLD BY LEADING DEALERS IN BOSTON PROVIDENCE NEW HAVEN NEW YORK BUFFALO PHILADELPHIA PITTSBURGH BALTIMORE WASHINGTON LOUISVILLE CINCINNATI ST. LOUIS INDIANAPOLIS CHICAGO CLEVELAND DETROIT PORTLAND LOS ANGELES SAN FRANCISCO SEATTLE AND OTHER IMPORTANT CENTERS



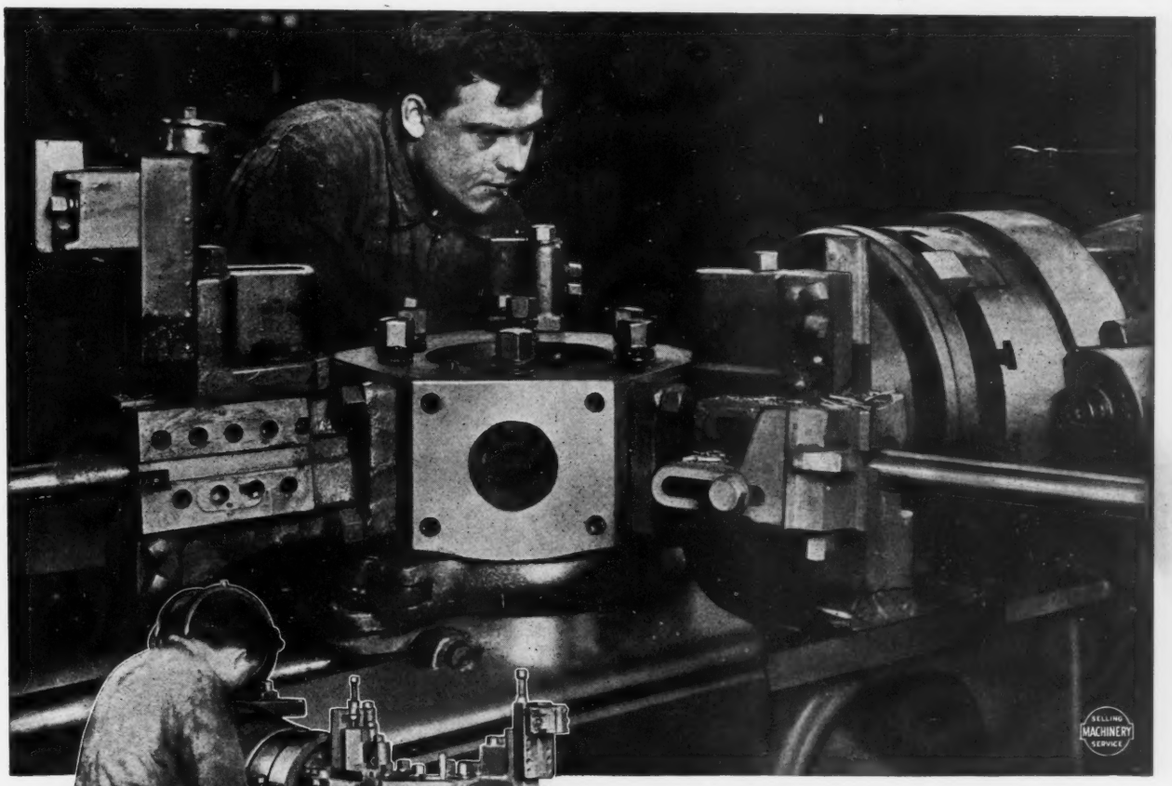
EXTRA TRADE X. F. MARK FINE

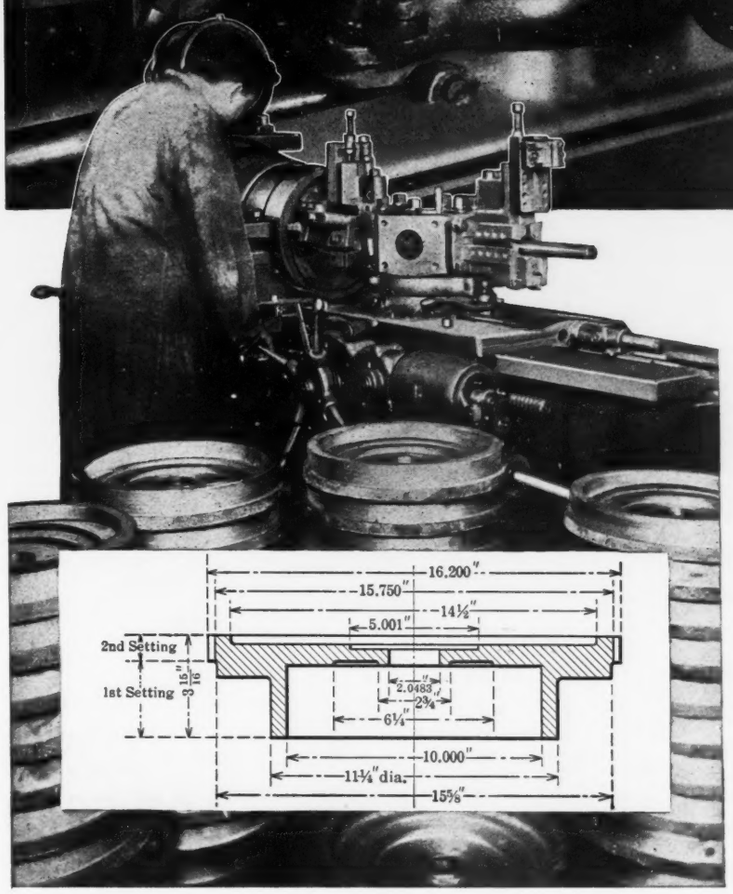
Swiss Pattern Files

PEEK over his shoulder sometime when he is on a very exacting job, and when he lays his file down, notice the name on the tang.

He chooses the Nicholson X. F. Swiss Pattern because its absolute uniformity helps *him* do best work.

NICHOLSON FILE CO.
Providence, R. I., U. S. A.





"LIBBY"

A GOOD TURRET LATHE

Libby Lathes have solved so many vexing production problems that the phrase "Leave it to Libby" has come into being quite of its own accord—because so often the *only* way to get a tough job done is to "leave it to Libby."

Sometimes speed, sometimes accuracy, sometimes fine finish is the stumbling block. This automobile flywheel, for instance, was a little bit of everything—until they left it to Libby.

Two settings and several operations are required. The Libby time is only 19 minutes. Accuracy and finish are as excellent as could be desired.

You can do as well—the only secret is to "Leave it to Libby." How about it?

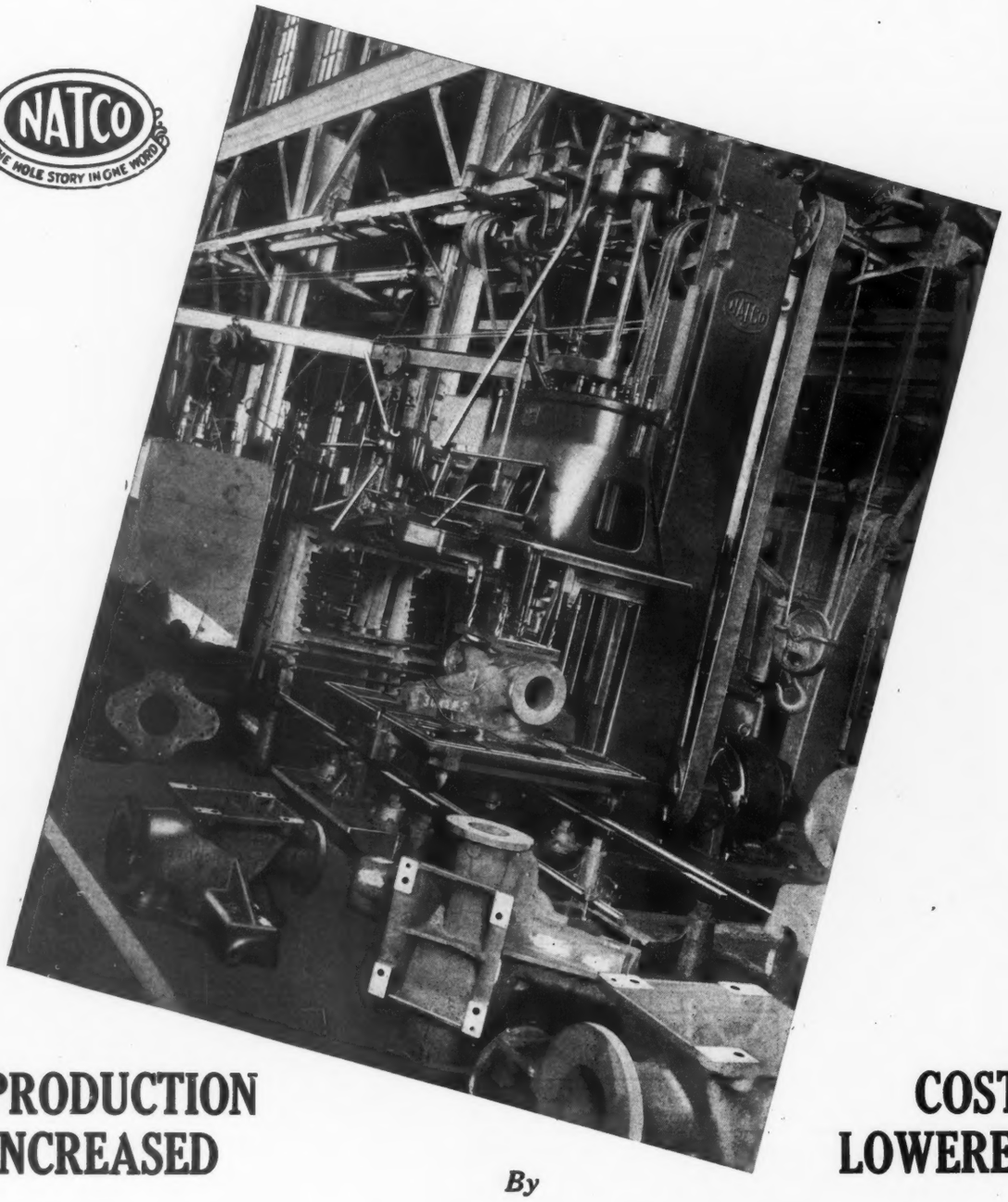
"Leave it to Libby"

INTERNATIONAL MACHINE TOOL COMPANY

INDIANAPOLIS, IND., U. S. A.

DOMESTIC AGENTS: Aumen Machinery Co., Baltimore, Md.; Blackman-Hill-McKee Machinery Co., St. Louis, Mo. Brown & Zortman Machinery Co., Pittsburgh, Pa.; Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore., Seattle Wash.; E. L. Essley Machinery Co., Chicago, Ill., Moline, Ill., Milwaukee, Wis.; Hill, Clarke & Co., Boston, Mass. Seifreat-Elstad Co., Cincinnati, Ohio, Dayton, Ohio; Strong, Carlisle & Hammond Co., Detroit, Mich., Cleveland, Ohio; Syracuse Supply Co., Syracuse, N. Y., Buffalo, N. Y., Rochester, N. Y.; Vandyck Churchill Co., New York City, N. Y.; New Haven, Conn., Philadelphia, Pa. Peden Iron & Steel Co., Houston, Texas. FOREIGN AGENTS: Coats Machine Tool Co., London, England; Ing. Ercole Vaghi, Milan, Italy; Isbecque Todd & Co., Belgium; Isnosskoff & Co., Petrograd, Russia, Moscow, Ekaterinburg, Russia; V. Lowener, Copenhagen, Denmark, Christiania, Norway, Stockholm, Sweden; Victor B. Mendoza Co., Havana, Cuba; Moerch & Roumet, Paris, France. Mitsui & Co., Japan.

NATCO PRODUCTION DRILLERS



PRODUCTION INCREASED

COSTS LOWERED

By

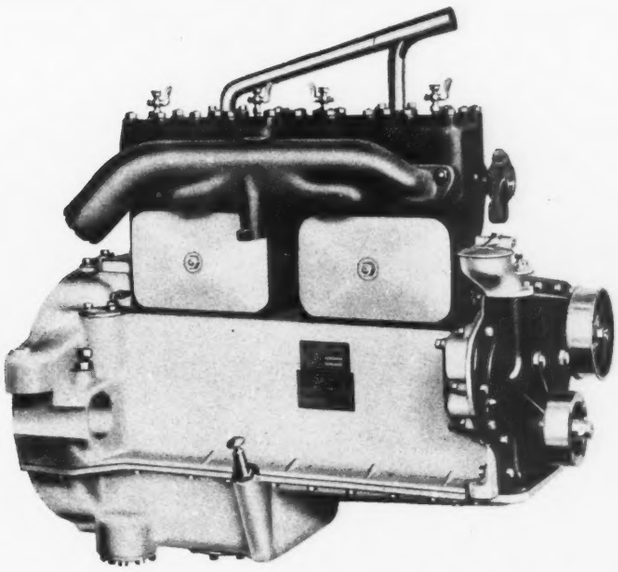
"NATCOS" with "TWO SPEED HEADS"

We call your attention to the different size holes drilled simultaneously at correct drill speeds.

THE NATIONAL AUTOMATIC TOOL CO.

RICHMOND, INDIANA, U.S.A.

W&B



Continental "Red Seal" Motors

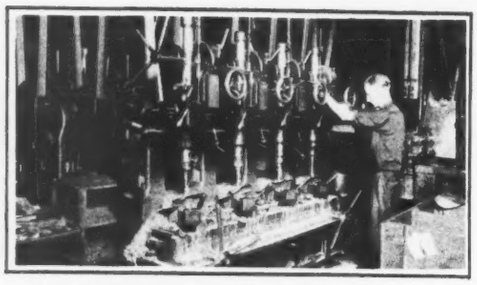
Whitman and Barnes take legitimate pride in the fact that their twist drills and reamers have for years been important factors in the production of the famous Continental "Red Seal" Motors in their great Muskegon plant.

Fifteen years ago Continental occupied less than two thirds of an acre with less than 16,000 square feet. Today including their Detroit plant they cover more than 1,750,000 square feet.

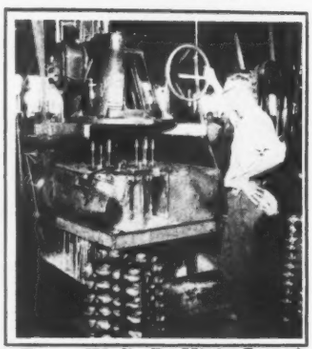
The Whitman & Barnes Mfg. Co.
Akron, Ohio.

CONTINENTAL MOTORS
Power of a Nation
AMERICA'S STANDARD

Whitman & Barnes Drills in Action at Continental Motors



W & B High Speed Drills 47/64 inch drilling Continental connecting rods.



Four W & B High Speed Drills 33/64 inch and two 11/32 inch drilling connecting rods on multiple spindle press.

A battery of W & B Number 35 High Speed wire drills drilling Continental Studs.

The photographs reproduced at the left, show Whitman & Barnes twist drills in three of their many operations.

Everywhere throughout this great Muskegon plant, the most exacting and accurate performance is demanded of twist drills and reamers.

Here again Whitman & Barnes twist drills and reamers are approved by an internationally famous manufacturer; another convincing proof of their unusual resistance to wear and their ability to produce holes rapidly and economically.

W. & B. WAREHOUSES:

99 Chambers St., New York City 565 W. Washington St., Chicago, Ill.

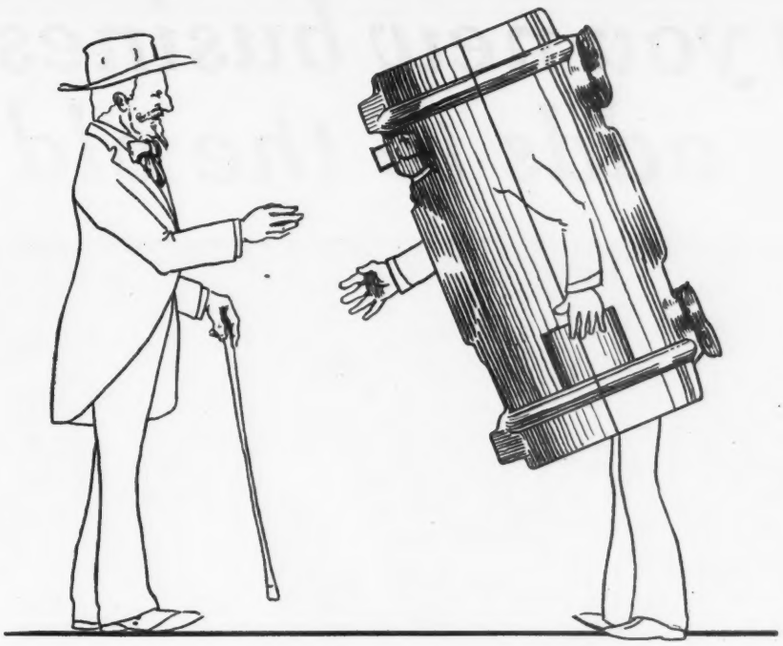
For complete list of distributors, see MacRae's Blue Book

Whitman & Barnes

AKRON, OHIO

TWIST DRILLS AND REAMERS

Photographs courtesy of Continental Motors



The Solid South
For
Split Hyatt Line Shaft Bearings

HYATT line shaft bearings have come to be accepted as standard equipment in many Southern plants.

The textile, cotton ginning, cottonseed oil, agricultural and lumber industries have realized the distinct advantages offered by these bearings and the ease with which they can be installed.

Being split, Hyatt bearings can be put on without removing pulleys, belts, collars or clutches, and without holding up production.

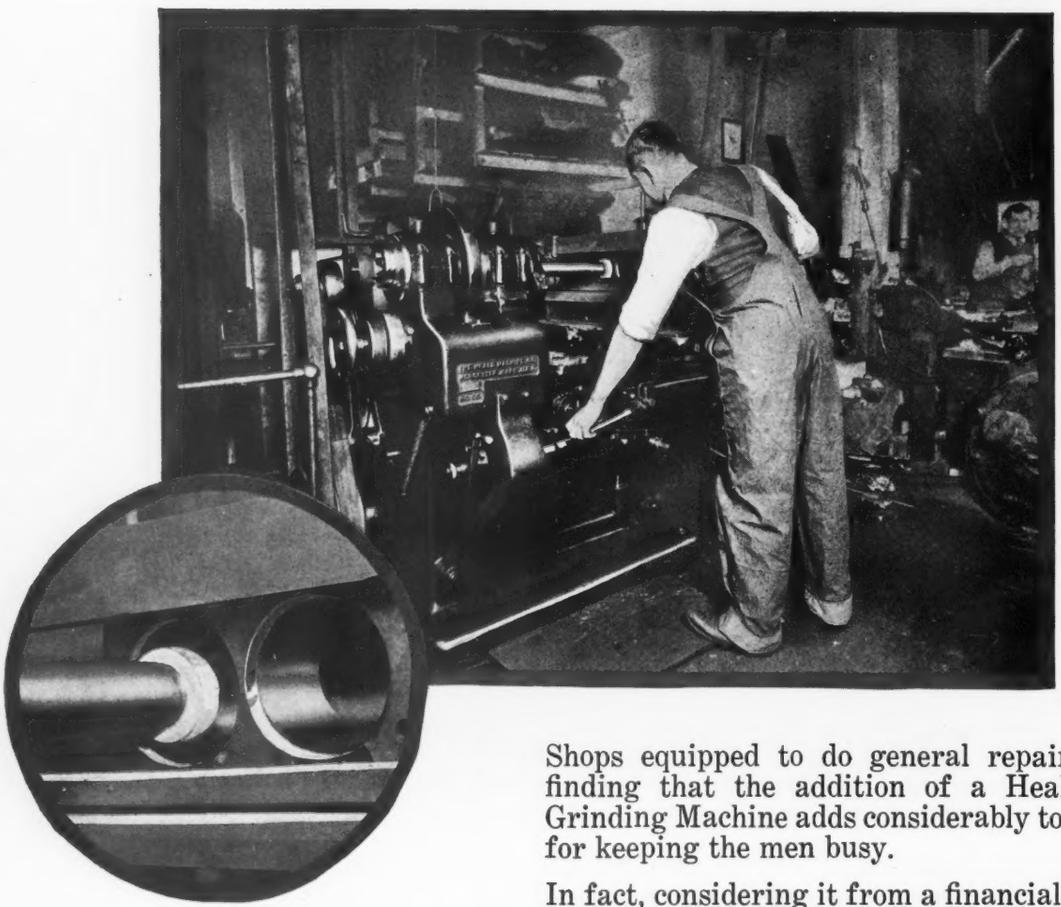
Once installed they effect a power saving of 15% to 20% and lubrication saving of 80%. Bearing repairs and adjustments are eliminated and the only attention required is oiling three or four times a year.

Hyatt Bulletin No. 130 contains some interesting information on power transmission. Write for a copy.

'Phone the Nearest Mill Supply Dealer

HYATT ROLLER BEARING COMPANY
NEWARK, NEW JERSEY
PACIFIC COAST ADDRESS: SAN FRANCISCO, CAL.

Gets you new business and adds to the old



GRIND WITH A HEALD AND BE SURE

Shops equipped to do general repair work are finding that the addition of a Heald Cylinder Grinding Machine adds considerably to the chances for keeping the men busy.

In fact, considering it from a financial standpoint, it pays big dividends on the capital invested and not only fills spare hours but is the means of creating other work for the balance of the shop.

This machine handles all classes of large miscellaneous internal grinding equally as well as automobile cylinders.

It is particularly desirable for a shop centrally located among a large number of registered cars from various small towns nearby, as it enables the repair man to give complete service which is so valuable to this class of trade.

Give us your name, location and business. We will help you decide the advisability of installing one of these machines. In the meantime write for our book

Heald Cylinder Regrinder

"Cylinder Regrinding as a Business"

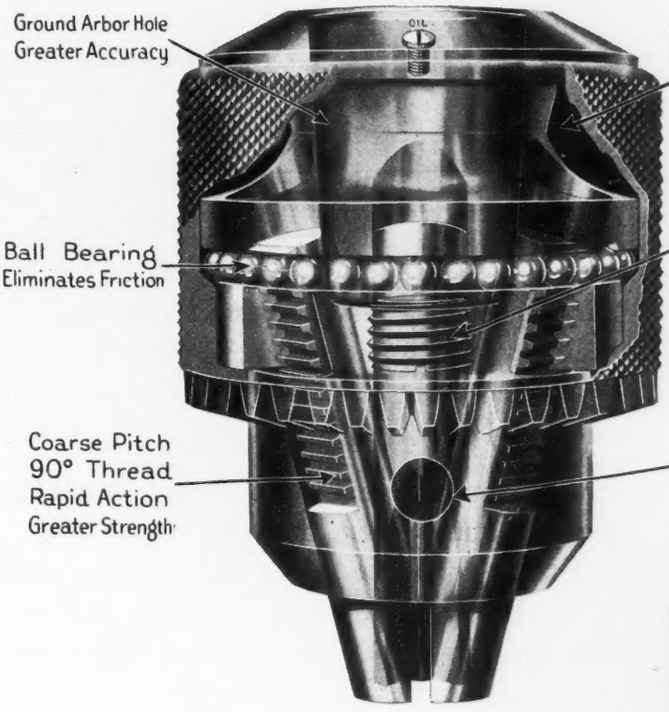
The Heald Machine Co.

16 New Bond Street, Worcester, Mass.

Carefully Made

Rigidly Inspected

Correctly Designed



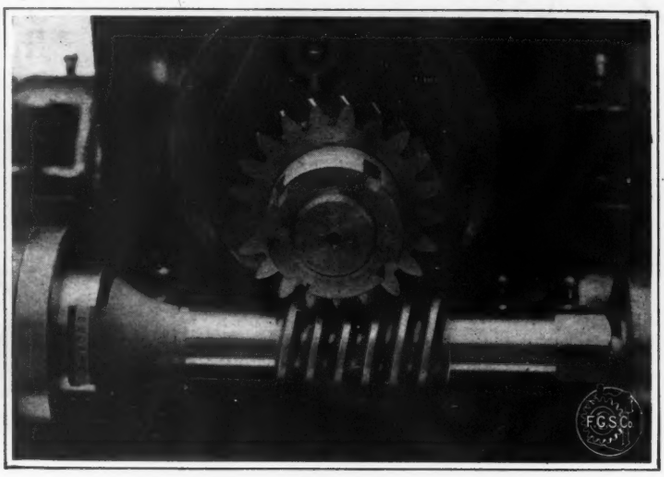
THE NEW JACOBS SUPER CHUCK

Moderately Priced

The JACOBS MANUFACTURING Co
HARTFORD, CONN., U.S.A.

The
Worlds Largest Producers
of Drill Chucks

Securely Packed



Thread Generation
and
The Question of Duplication

GIVEN an accurately-made cutter, such as the **Thread Generating Cutter,** which is ground all over after hardening.

And a machine, such as the **Thread Generator,** which is so designed and constructed that this accurately-made cutter can be positively controlled when in action on the work, **Duplication** of work is a certainty.

The **Thread Generator** and the **Thread Generating Cutter** meet these necessary requirements to a degree never before approached in a Thread Generating Machine. Added to this are production possibilities that exceed your most hopeful expectations.

A quotation on your work will not obligate you in any way

The Fellows Gear Shaper Company
SPRINGFIELD, VERMONT

Makers of Gear Cutting Machinery and Cutters for the past Quarter of a Century

Branch Office, 505 Book Building, Detroit

FOREIGN AGENTS:—Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Anonyme Belge Alfred Herbert, Brussels, Belgium; Alfred Herbert (India) Ltd., Head Office, Calcutta, India; Bohm & Bormann, Berlin, Germany.

PACIFIC COAST REPRESENTATIVES:—Harron, Rickard & McCone, San Francisco and Los Angeles, California; Nevada; Arizona.

B & R BEARINGS

You Rush for a Bargain

Let somebody drop the news that something you want can be bought at a bargain, and off you rush to buy it—perhaps to save only a few cents.

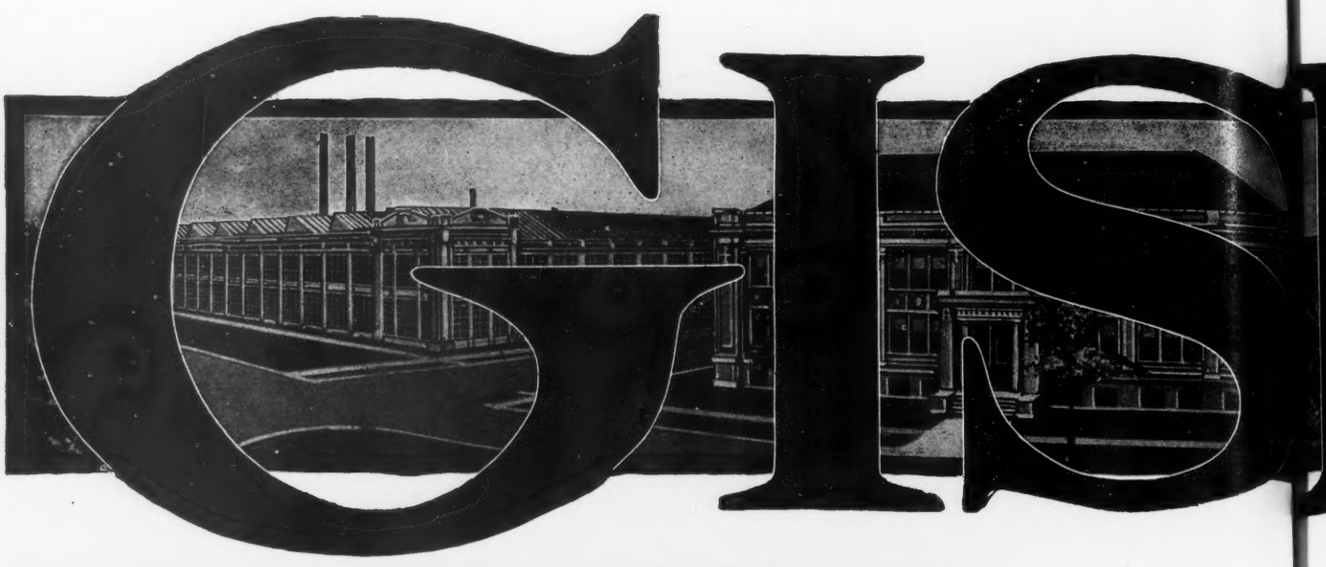
But the biggest bargain you'll find, where the savings mean perhaps thousands of dollars, are the Ball and Roller Bearings with which you can eliminate *friction* in your transmission equipment and machinery.

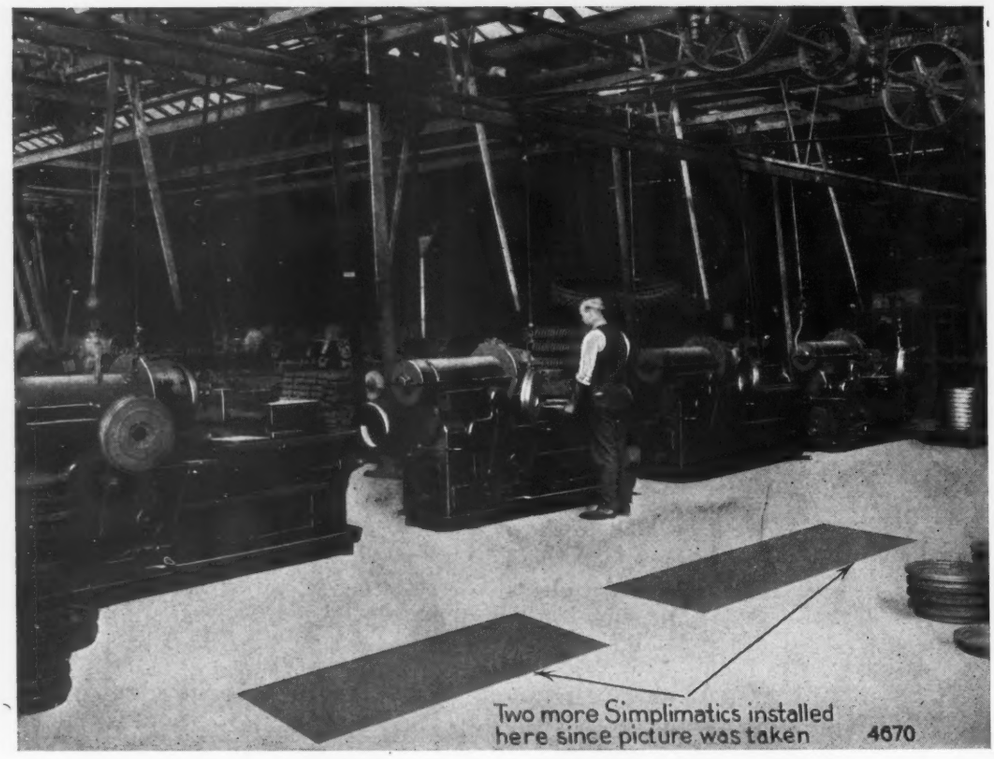
If Ball and Roller Bearings cost twice as much as they do, they would still be a big bargain; their installation cost is saved many times over in reduced power bills, the facility to operate at higher speeds, and lowered labor costs due to the elimination of the oiling, care and renewal required by ordinary bearings.

We'll be glad to show convincing facts and figures from the plants of B & R users.

The Ball & Roller Bearing Co.

DANBURY, CONN., U. S. A.





The Simplimatic Lathe

The tremendous capacity of the Simplimatic to produce huge daily runs of duplicate parts without supervision other than chucking and unchucking of the piece, will appeal at once to every manufacturer interested in improving present production methods.

The Simplimatic has the productive capacity of a specially designed machine, yet it is readily adaptable to a wide range of work such as the finishing of:

Pipe flanges	Ball bearings	Commutator caps
Bevel gears	Bearing retainers	Rotor flanges
Pistons	Transmission gears	and many other pieces

THE SIMPLIMATIC LATHE

The Simplimatic is a thoroughly tried out, highly productive lathe which meets the need of a simple automatic machine capable of taking a number of cuts simultaneously on a variety of chucking and between-centers work.

Its application to each job gives the production of a machine solely designed for that particular job, and its adaptability to different kinds of work is one of its greatest advantages.

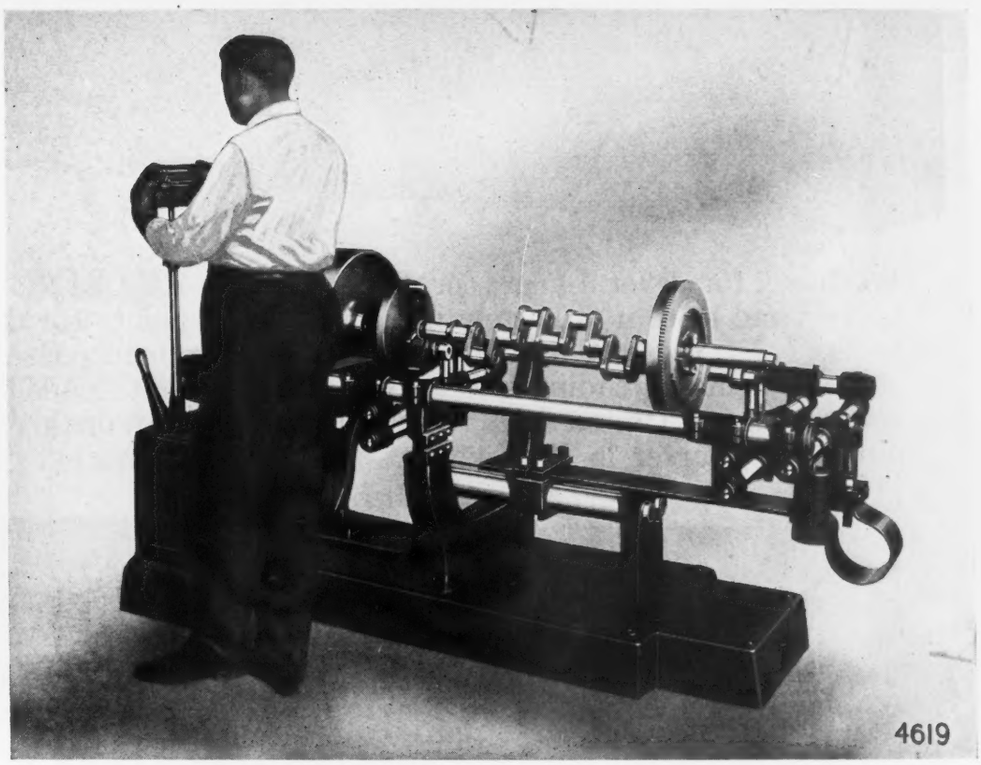
Simplimatics in groups of ten to twenty-six are in daily use in twenty-five plants of twenty-two different firms. Ten of the twenty-two users have re-ordered. Detailed information will be sent upon your request.

GISHOLT MACHINE COMPANY M

30 Church St.,
New York, N. Y.

1300 East Wash ingt

GISHOLT



The Precision Balancing Machine

A mathematically accurate machine which rapidly and unfailingly measures the amount and position of unbalance in rotative parts. It has solved a great problem that has been the bane of the automotive world for many years.

Among the many parts which can be balanced correctly on this machine are:

Crankshafts	Pump Rotors	Grinder parts
Fly Wheels	Pulleys	Clutches
Motor and Generator Armatures	Fans	and other rotative parts
	Spindles	

THE PRECISION BALANCING MACHINE

The attention of the engineering world and also the buying public is now strongly directed toward the detrimental effects of vibration, and Gisholt Machine Company offers to progressive machinery manufacturers the first complete and efficient solution of the problem.

The Precision Balancing Machine will uniformly and accurately **measure** the amount of unbalance and positively locate the point of correction. With it you can correct simultaneously both static and dynamic unbalance.

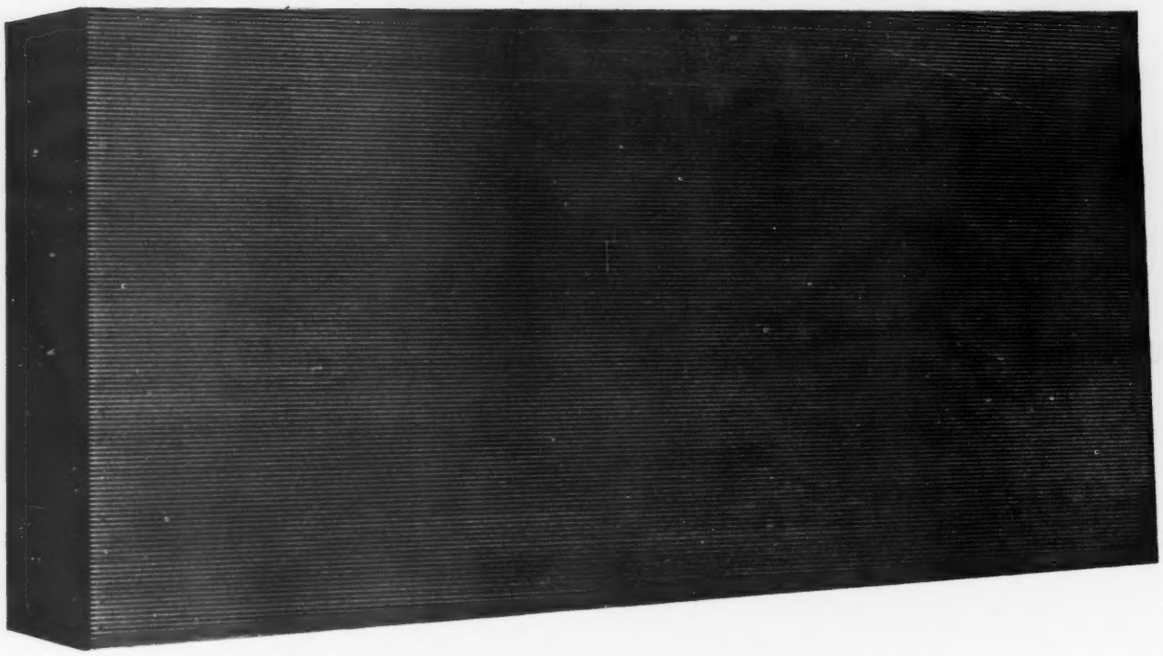
Gisholt Engineers have made an exhaustive study of the balancing problem and will gladly tell you how Precision Balanced parts will help you improve your product. Just send drawings of your rotative parts and tell us what trouble you are having.

Y MADISON, WISCONSIN, U. S. A.

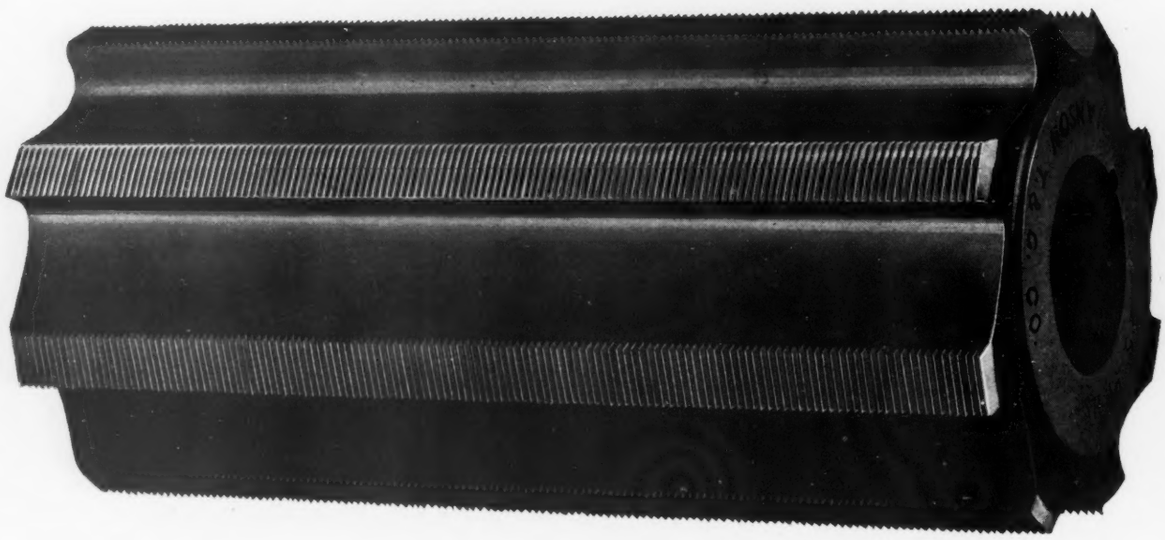
Wash ington Avenue

1888 Page Ave.,
Cleveland, Ohio

THREAD ROLLING DIES



We have, for several years, produced perfect **ROLLING DIES** for screws and have now largely increased our capacity for this kind of tools. These dies are hardened and ground to unsurpassable accuracy. We grind threading dies in pitches from 100 threads to the inch and coarser in United States Standard and V form of thread, and 40 pitch and coarser in Whitworth.



We recommend our **HIGH SPEED HOBS** for thread rolling dies. These hobs are finished exceedingly accurate by Hanson Grinding Process in pitches from 100 per inch and coarser.

The Hanson-Whitney Machine Co.

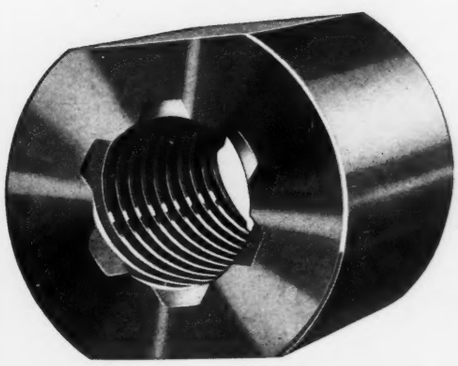
Hartford, Conn.

2½" dia. 2 pitch single Acme Nut, 8" long.

"HANSON" H PROCESS

Double Acme Thread Tap

You can tap any kind of nut to fit any precision screw with "Hanson Process" taps. No chasing of thread necessary.



1 9/16" diam. ¼" pitch 1½" lead sextuple Acme Nut 31" long.

Made only by

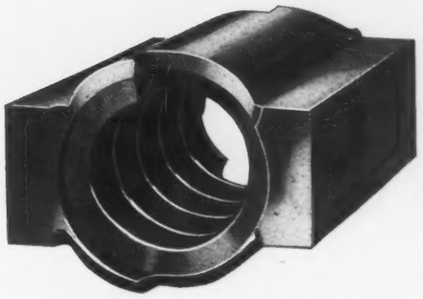
The Hanson Tap & Gauge Co.

169 Bartholomew Ave.

HARTFORD, CONN.

REPRESENTATIVES

New York, N. Y.	L. C. Biglow & Co.
Syracuse, N. Y.	George McPherson
Boston, Mass.	George C. Steil
Philadelphia, Pa.	D. J. Normoyle
Pittsburgh, Pa.	William K. Stamets
Cleveland, Ohio	William K. Stamets
Cincinnati, Ohio	Seifreat-Elstad Co.
Dayton, Ohio	Seifreat-Elstad Co.
Detroit, Mich.	English & Miller Mchy. Co.
San Francisco, Cal.	A. H. Coates Co.
Chicago, Ill.	E. H. Huntington



1¾" diam. ⅝" lead. Special form thread nut 5" long.

Vastly superior to a Straight Carbon Steel, therefore when

Urgent that strict economy be practiced

Large and small users

Continually substitute Vulcan Special Vanadium for

Straight Carbon Steel and they

Never regret it.

Makers of
Wolfram High Speed Steel
The Standard for Uniformity
Vulcan Special Vanadium
Outwears Straight Carbon Steel
Vulcan Carbon Steel & Special Steels

VULCAN CRUCIBLE STEEL CO.

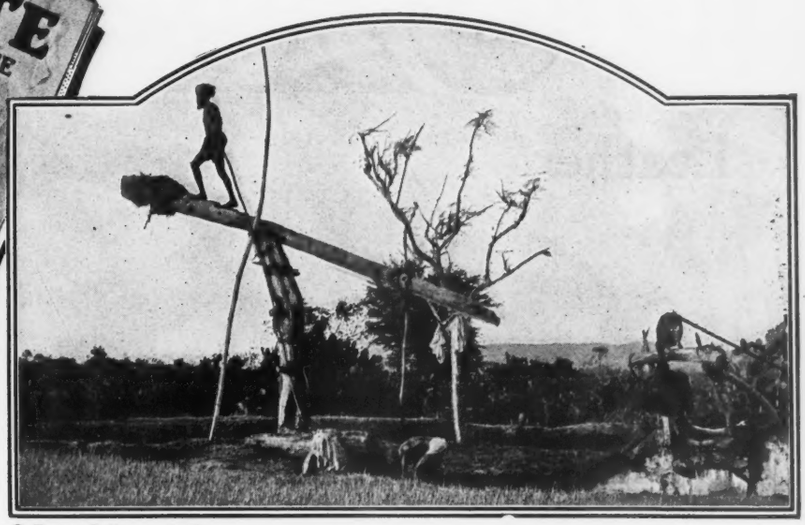
Established 1900

HOME OFFICE AND WORKS: ALIQUIPPA, PA.

BRANCHES

New York—50 Church St., Room 384
Chicago—16-18 South Clinton Street
St. Louis—267 International Life Bldg.
Detroit—4843 Bellevue Avenue

New England Representative
Hartel Bros. & Co.
307 Atlantic Ave., Boston, Mass.



© *Ewing Galloway, N.Y.*

This message is from the cover of the Oakite News Service, 80,000 copies of which go regularly to readers who thus keep in touch with the latest developements of industrial cleaning methods

Near Mahabalipuram—

ONE might think the man on the log was getting ready for a high dive, but he isn't. When he walks out to the end of the log, his weight brings it down, thus lifting a big, leather bucket of water from an irrigation canal to the level of the rice field.

His job is to walk back and forth—and to watch his step! A queer method of lifting water, you say? Yes, but that is how it is done where this picture was taken, near Mahabalipuram, India.

Yet, strange as it may seem, there are cleaning methods used in some of our otherwise progressive manufacturing plants today that are equally as "queer" in the light of modern practice. Which prompts us to say—

If you are in doubt whether your present operations or methods are as effective or economical as they should be, ask an Oakite service man to stop in and go over them with you. The chances are in your favor that you'll profit by whatever suggestions he has to offer.

There are 70 Oakite Service Men, cleaning specialists, located at:

Allentown, Pa.	*Minneapolis
Atlanta, Ga.	*Montreal
Baltimore	Newark
Boston	New Haven
Bridgeport	*New York
*Brooklyn	*Oakland, Calif.
Buffalo	Peoria
Camden	Philadelphia
Canton, O.	Pittsburgh
Charlotte, N.C.	*Portland, Me.
*Chicago	Poughkeepsie
*Cincinnati	Providence
*Cleveland	Reading
*Dallas	Rochester
*Davenport	Rockford
Dayton	Rock Island
*Denver	*San Francisco
*Des Moines	Schenectady
*Detroit	*Seattle
Erie	*St. Louis
Flint, Mich.	Syracuse
Grand Rapids	Toledo
Harrisburg	*Toronto
Hartford	Utica
*Indianapolis	Waterloo, Ia.
*Kansas City	Williamsport, Pa.
*Los Angeles	Worcester
*Milwaukee	

*Stocks of Oakite materials are carried in these cities

Oakley Chemical Co. *General Offices:* **26 Thames St., New York, N.Y.**

OAKITE

Trade Mark Reg. U. S. Pat. Off.

Industrial Cleaning Materials

DUXBAK

Leather Packings

"U" Packings

Cups

Flanges

an economical investment

Poor or even mediocre packings at any price are expensive, for the saving in first cost is more than offset by the expense and inconvenience of frequent renewals.

Duxbak leather Packings are the best investment—most economical. They are made from a special tannage which produces a leather that combines all the good features of both oak and chrome leather. They do not swell or shrink, are unaffected by water or oil and withstand a very high degree of heat.

Duxbak leather Packings are unusually tough and durable—even exceeding chrome leather in wearing qualities. Made for either hydraulic or pneumatic service.

Send for packing booklet and let us quote you on your requirements.

DUXBAK LEATHER PACKINGS
TRADE MARK
REG. U.S. PAT. OFF.

Chas. A. Schieren Company
ESTABLISHED 1868

Tanners
Belt Manufacturers

Tanneries: Bristol, Tenn.

Main Office and Factory:
73 Ferry Street, New York, U. S. A.

MILLING CUTTERS

ALL KINDS FOR ALL PURPOSES

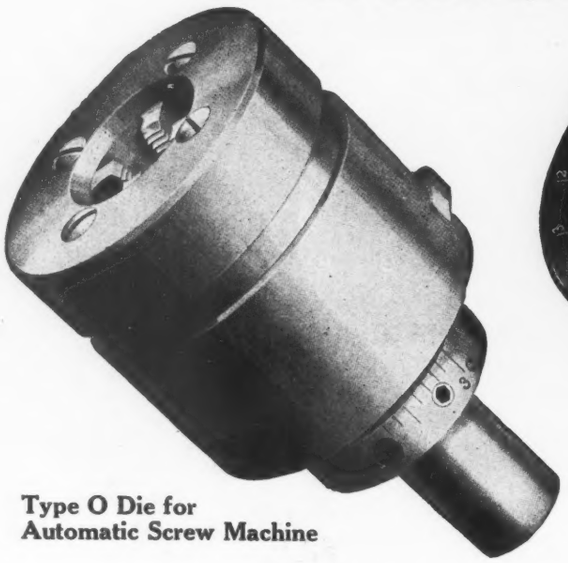
THE STANDARD TOOL CO.

CLEVELAND

New York Store, 94 Reade St. Chicago Store, 552 W. Washington Blvd. Boston Store, 1101 Scollay Bldg.
Philadelphia, 401 Liberty Bldg.

MURCHEY TOOLS

Lever Handle Collapsible Tap



Type O Die for
Automatic Screw Machine

Type A
Self-opening Die

Speed and Economy in Every Thread

The proof of quality is performance. And Murchey performance is yours for the asking. All we ask is that you try Murchey Thread Cutting Tools, *at our expense*, and see how well they combine the advantages of accurate threads, speedy production, long service and low cost.

Made for practically every class of threading work. Self-opening Die-heads can be adjusted to .0005″ by means of knurled indexed ring—sizes from 3/32″ to 12″ capacity.

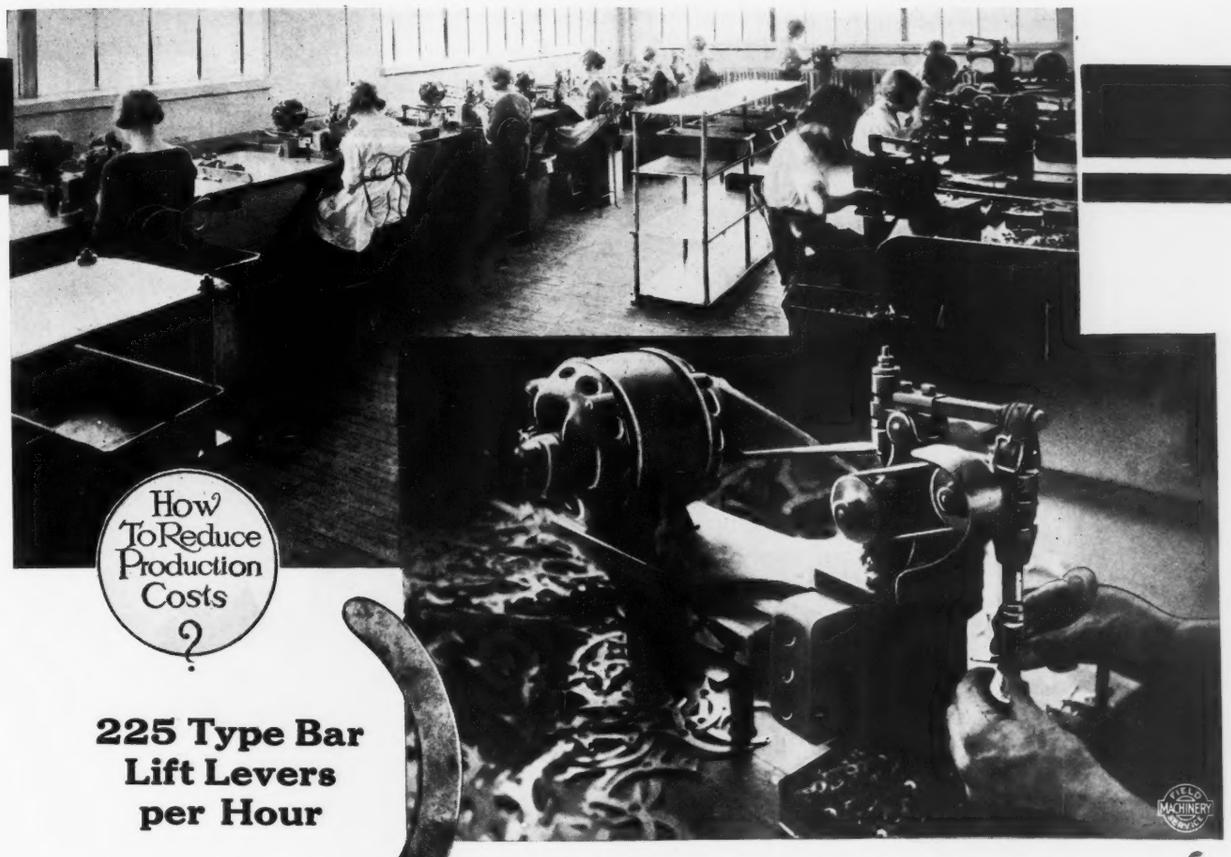
Standard Machine Taps in sizes from 1¼″ to 12″.

Your blueprints on unusual threading operations will bring prompt estimates. Let us tell you more about the Murchey way to cut threading costs.

MURCHEY MACHINE & TOOL COMPANY

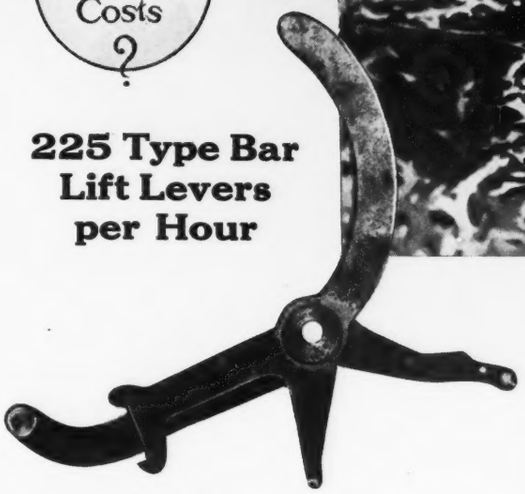
34 PORTER STREET, DETROIT, MICH.

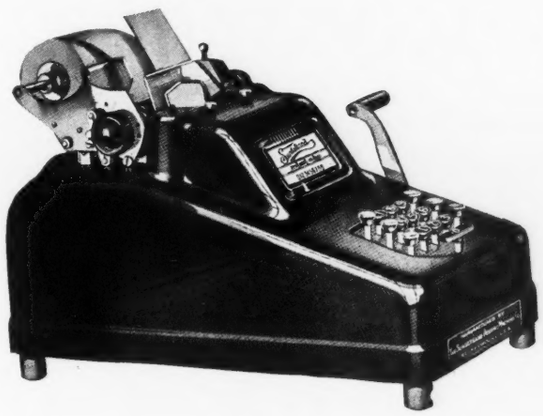
613 Atlantic Building, Philadelphia. 6523 Euclid Ave., Cleveland. Pittsburgh Representative, Laughlin-Barney, 483 Union Trust Bldg. Chicago Representative, R. E. Ellis Engineering Co., 621 Washington Blvd. San Francisco Representative, Smith-Booth-Usher, 50-60 Fremont St. Los Angeles Representative, Smith-Booth-Usher, 228 Central Ave. Fenwick Freres & Co., 8 Rue de Rocroy, Paris. Coats Mach. Tool Co., 14 Palmer St., Westminster, London, S.W., England.



How To Reduce Production Costs ?

225 Type Bar Lift Levers per Hour





Adding Machine Building with

HIGH SPEED RIVETING HAMMERS

(Patented)

To look at the many and various stampings which go to make the modern adding machine is to realize the countless riveting operations on which such machines depend for their proper operation.

The Sundstrand Adding Machine Company, Rockford, Ill., standardized on High Speed Riveting Hammers for this important work, because of the speedy, "human" stroke which assured satisfactory riveting, yet gave the necessary freedom to each moving member of the figuring device.

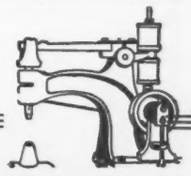
In the operation shown, type bar lift levers are being riveted with double shoulder rivets at the rate of 225 per hour on one of the eleven High Speed Riveting Hammers in this department.

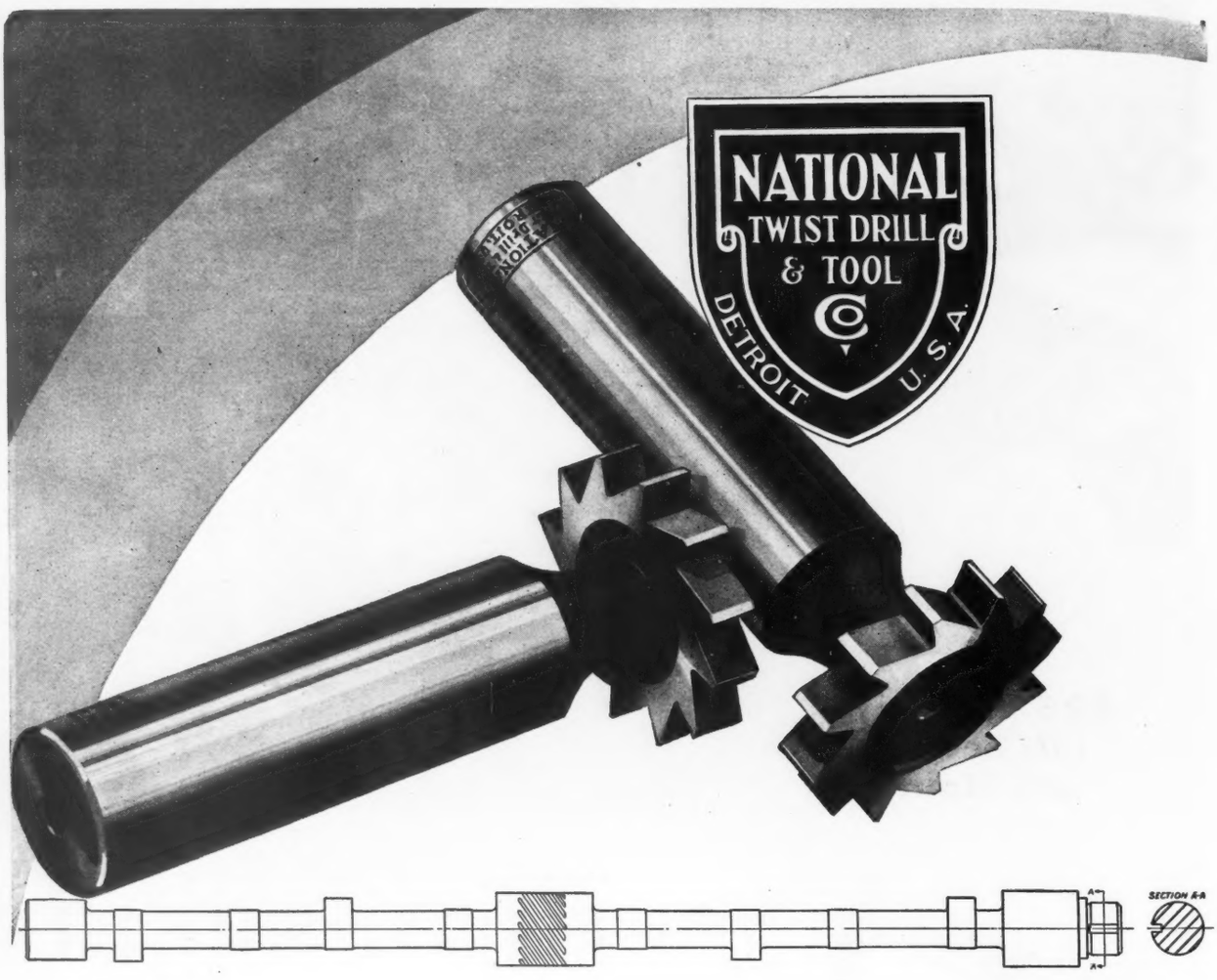
Production estimate furnished on receipt of parts or prints.

THE HIGH SPEED HAMMER COMPANY, Inc.

THE PRINCIPLE IS RIGHT — **ROCHESTER, NEW YORK** — **THE HAMMER WITH THE HUMAN STROKE**

AGENCIES: Burton, Griffiths & Co., Ltd., London, E. C., for the British Isles. Aktiebolaget Rylander & Asplund, Stockholm, Sweden, for Sweden and Finland. China, Japan and South American Trading Company, Ltd., Yokohama, Kobe and Osaka, Japan, for Japan and Dependencies.





Practical - Economical

Milling the keyway in this automobile camshaft is done exclusively with Woodruff Keyway Cutters. ~ ~

The correct design as to numbers of teeth, side clearance, and the proper heat-treatment, makes our cutters especially fitted for an operation of this kind. ~ ~

Numbered among our many satisfied customers are most of the larger automobile manufacturers. ~ ~

Do you appreciate the significance? ~ ~ ~ ~

TWIST DRILLS · REAMERS · HOBS · MILLING CUTTERS · SPECIAL TOOLS

NATIONAL TWIST DRILL & TOOL COMPANY

DETROIT, U. S. A.

MANUFACTURERS of PARABOLIC MILLING CUTTERS

and 7/16 DRILLS

BRANCHES

NEW YORK, N. Y. 73 Warren Street · PHILADELPHIA, PA. 43 North Sixth Street · CHICAGO, ILL. 26 South Jefferson Street · SYRACUSE, N. Y. 107 Gifford Street · BUFFALO, N. Y. 76 Pearl Street

SPRINGFIELD "IDEAL" LATHES

A Big Majority of Shop Executives

The steady trend toward the Springfield Geared Head Lathe by a big majority of shop executives, men whose equipment must be modern and give modern service, is a strong indication that these machines are giving results that users expect of them—that they are living up to their reputation.

A few of the exclusive features embodied in the Springfield Geared Head Lathe that help to assure its permanently reliable service are: High Power, Correct Speeds, Ideal Rapid Gear Change, Micrometer Accuracy. All Journals and Bearings, except main spindle journal, are *ball bearings*.

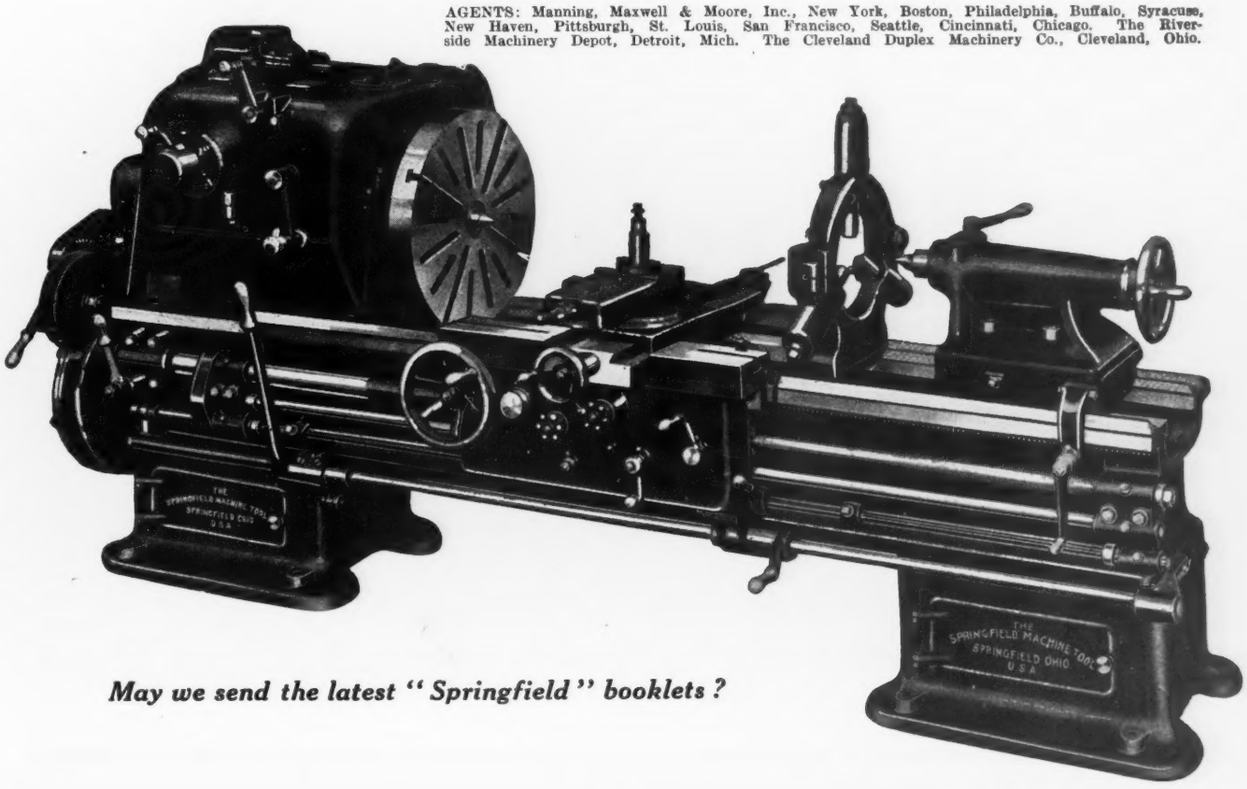
You are interested in better service, better and more economical production—therefore, write us, we'll be glad to help.

THE SPRINGFIELD MACHINE TOOL CO.

Manufacturers of Springfield Lathes and Shapers

631 Southern Avenue **Springfield, Ohio, U. S. A.**

AGENTS: Manning, Maxwell & Moore, Inc., New York, Boston, Philadelphia, Buffalo, Syracuse, New Haven, Pittsburgh, St. Louis, San Francisco, Seattle, Cincinnati, Chicago. The Riverside Machinery Depot, Detroit, Mich. The Cleveland Duplex Machinery Co., Cleveland, Ohio.



May we send the latest "Springfield" booklets?

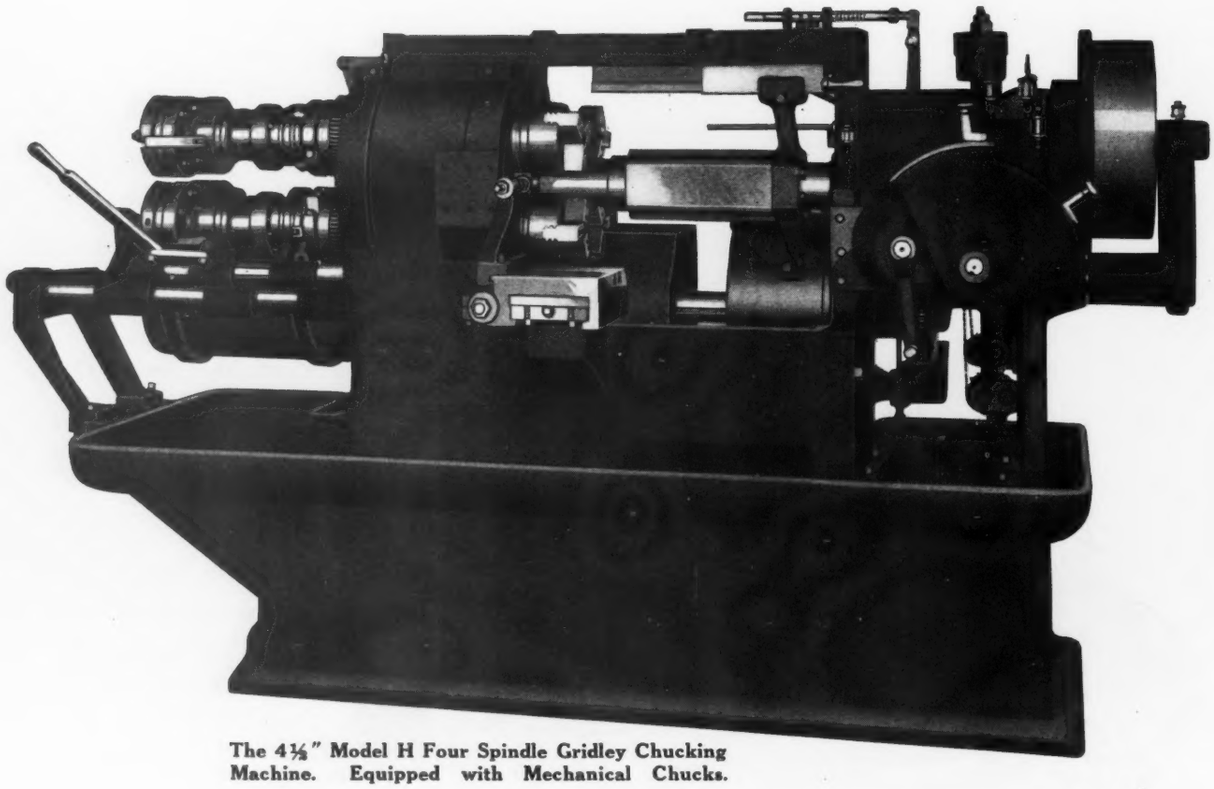
Meet—
This New Gridley Chucking Machine

At one plant where they are using this new four-spindle Gridley Chucking Machine, they tell us that they are producing on it in 16 seconds a piece that formerly required 3 minutes to machine.

Have you any chucking work ranging up to 4½" in diameter? If you have you owe it to yourself to get the facts and figures on this new Gridley Machine.

The Gridley Chucking Machine can be equipped with either mechanical chucks or with air chucks. The largest piece which can be swung is 6½" O.D. with a chucking capacity of 4½" O.D.

Ask for our booklet describing and illustrating the Gridley 4½" Model H Chucking Machine. Better yet send in blueprints or samples for definite figures on your work —no obligation.

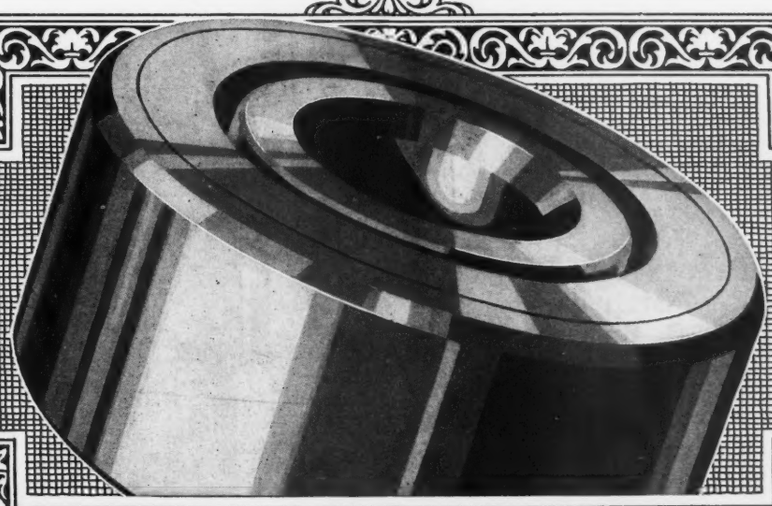


The 4½" Model H Four Spindle Gridley Chucking Machine. Equipped with Mechanical Chucks.

The National Acme Company

Cleveland, Ohio—Windsor, Vt.

New York Chicago Detroit



New Departure Ball Bearings

The Triple Function Bearing

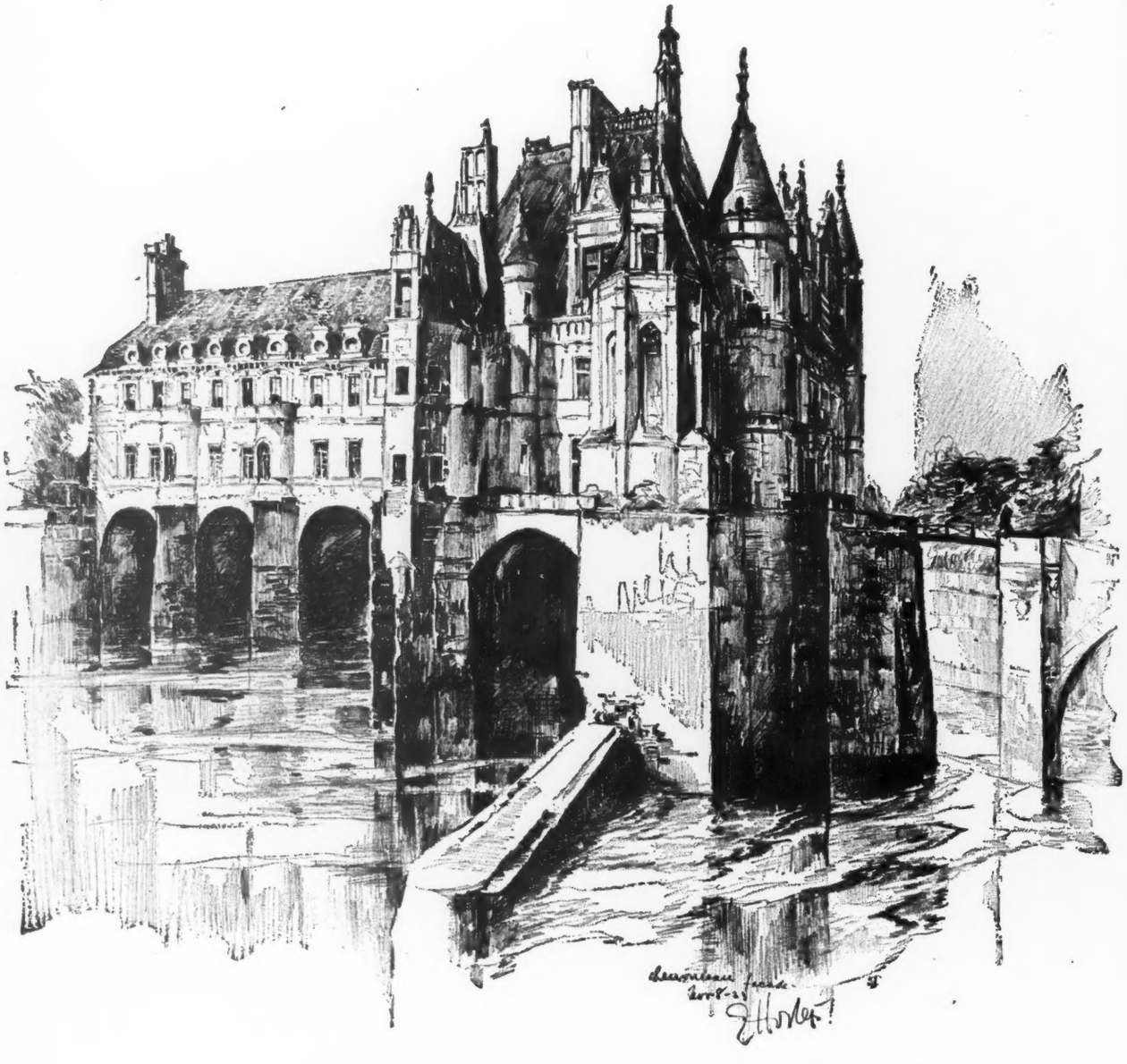
BEFORE the advent of the New Departure *Double Row type* it was customary to use a separate ball bearing for each load function. This meant that often *three* bearings were necessary to do the work for which the New Departure Double Row is now so often specified.

Other and less efficient bearing types than those employing balls can at best perform but two functions: support a radial and a *one* direction thrust load.

Wherever you would combine highest efficiency with the least cost and the least structural complication for supporting a combination of radial loads and thrust in *any* direction, specify the New Departure Double Row type.

THE NEW DEPARTURE MANUFACTURING CO.,
Detroit BRISTOL, CONNECTICUT Chicago

28



THIS pencil drawing of the chateau of Chenonceaux, on the river Cher, in central France, is one of the most charming renderings Earl Horter has ever made. Ten pages of manuscript could bear no more eloquent testimony to the quick responsiveness and superlative quality of

DIXON'S ELDORADO

"the master drawing pencil"

JOSEPH DIXON CRUCIBLE COMPANY
Pencil Dept. 74-J Jersey City, N. J.
Canadian Distributors, A. R. MacDougall & Co., Limited, Toronto

DIXON'S ELDORADO ERASER

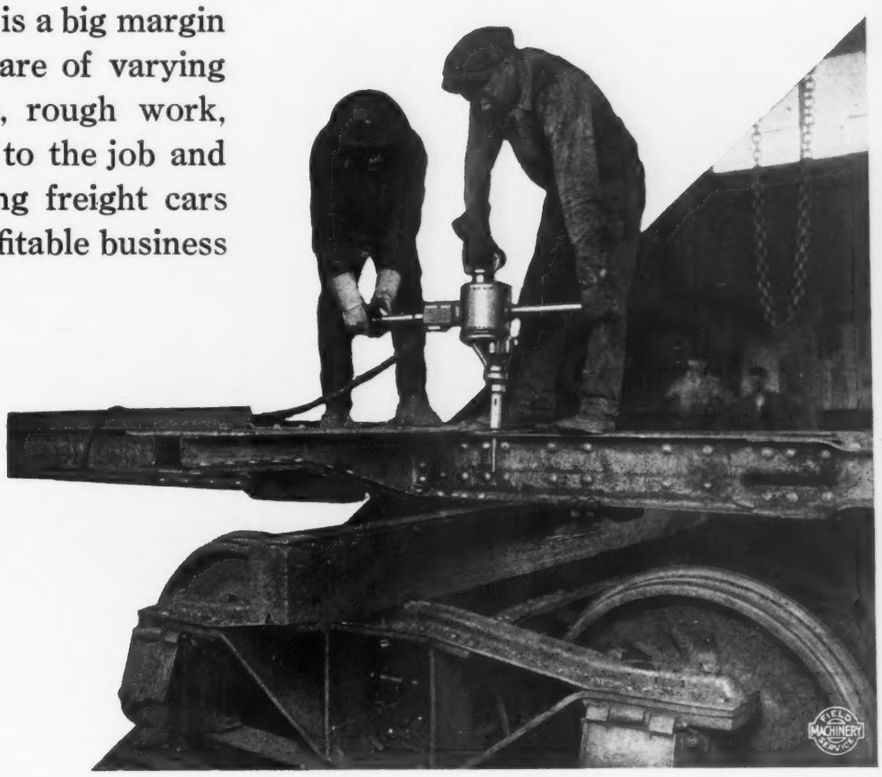
A worthy partner of Dixon's Eldorado pencil. Soft—pliable—yet firm enough to clean the drawing without crumbling into aggravating little bits. Made in 12 sizes. Write for a sample. Free on request.

SAMPLE OFFER Write for full-length free samples of *"The master drawing pencil"* and of Dixon's "BEST" Colored Pencils. In their field, the "BEST" Colored Pencils hold the same position of supremacy as Dixon's Eldorado.

New Cars for Old

REPAIR work on the freight cars that come to the Koppel Car Repair Co., Koppel, Pa. begins with stripping them down to the sills—when they come out of the shop they are new cars to all practical purposes. After rivets are removed, hundreds of holes must be redrilled and reamed—and all this is done with Little Giant Portable Electric Drills.

In these tools there is a big margin of safety to take care of varying loads, high speeds, rough work, etc. They stand up to the job and help make salvaging freight cars a practical and profitable business for all concerned.



Little Giant Portable Tools—Electric and Pneumatic—for all classes of work. Let us tell which type best meets your needs.

Chicago Pneumatic Tool Company

6 East 44th Street, NEW YORK, N. Y.

*Sales and *Service Branches all over the World*

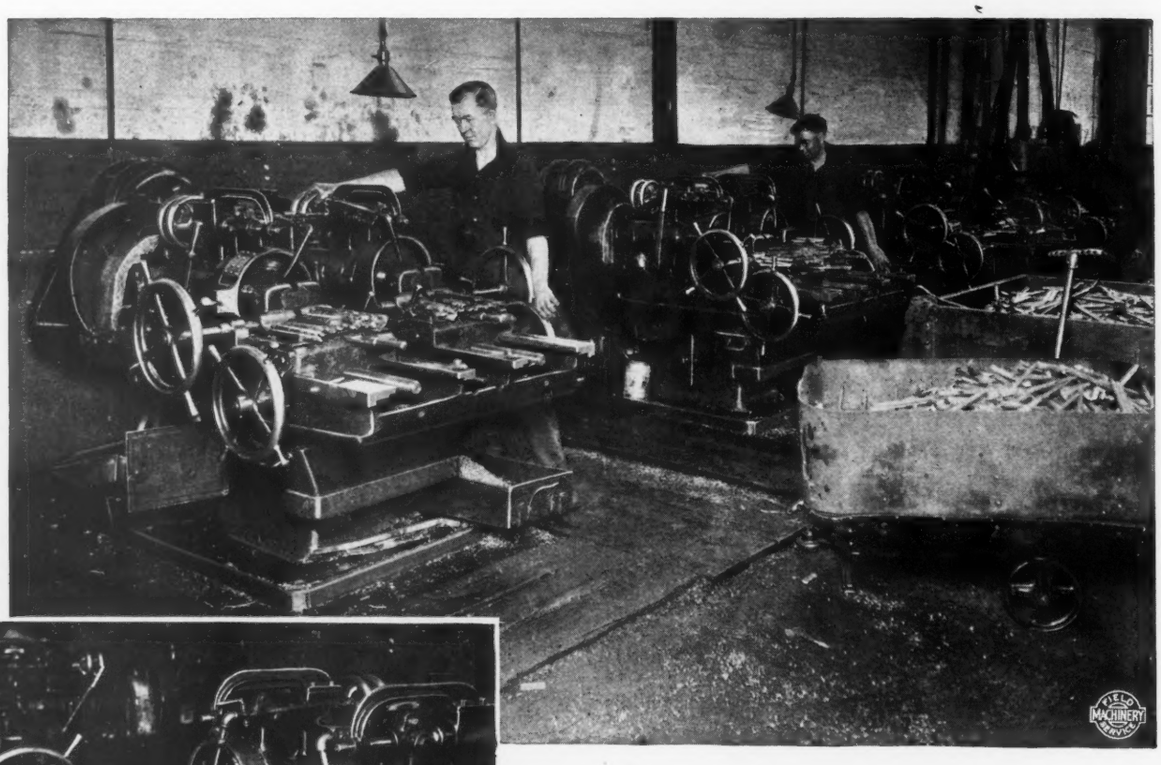
*Birmingham	Denver	*Los Angeles	*Philadelphia	*San Francisco	Berlin	Calcutta	*Havana	Kobe	Moncton	Paris	*Sao Paulo	Timmins
*Boston	*Detroit	*Minneapolis	*Pittsburgh	*Seattle	Bombay	Christiania	Helsingfors	London	*Montevideo	*Rio de Janeiro	Seoul	Tokyo
*Chicago	El Paso	*New Orleans	Richmond	*St Louis	Brussels	Dairen	Honolulu	Manila	*Montreal	Rotterdam	Shanghai	*Toronto
*Cincinnati	Houston	*New York	Salt Lake City	Tulsa	*Buenos Aires	Durban	Johannesburg	Milan	Osaka	Santiago	Tampico	*Vancouver
*Cleveland												*Winnipeg

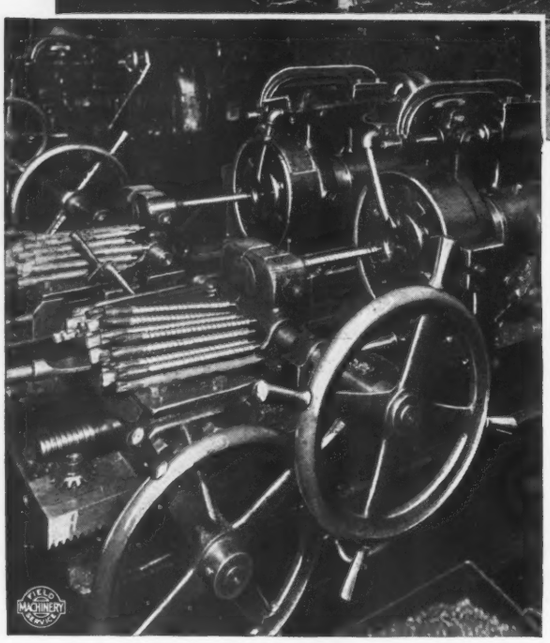
Canadian Pneumatic Tool Company, Ltd., Montreal, manufacturers of Chicago Pneumatic products in Canada
Consolidated Pneumatic Tool Company, Ltd., London, manufacturers of Chicago Pneumatic products in England

EL-96

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES ROCK DRILLS · · COAL DRILLS

CHICAGO *Electric* PNEUMATIC *Tools*





ACME Threading Machines

This battery of four Acme Threading Machines is cutting threads on screw shafts for automobile jacks. The material, .35 carbon steel, ¾" diameter, is threaded in one operation with square threads, three per inch, for a distance of seven inches. Production is 900 shafts per 9½-hour day—on a double-head machine.

Six years ago this company installed its first Acme machines—one single-head and one double-head. Recently two additional double-head machines were added. This is another case where Acme performance took care of the repeat orders.

900 automobile jacks per day—one machine

Let us tell you all about Acme Threading Machines and Die-heads

THE ACME MACHINERY COMPANY

CLEVELAND OHIO, U. S. A.

Foreign Agents: Burton, Griffiths & Co., Ltd., London. Glaenzer & Perreaud, Paris, France.

"Strom Ball Bearings are now standard equipment on our machines"

And he told us that in installing Strom Ball Bearings in his machinery he had succeeded in reducing costs of power by over 20%

He told us that after finding out how much power he could save by installing Strom Ball Bearings, he had subjected them to the most severe load and durability tests his engineers could devise to see how they would stand up. The results were so gratifying that they were adopted as regular equipment.

There's a reason, of course. Strom Ball Bearings are made of the finest chrome steel, heat-treated through and through. They are machined with scientific precision to 1/10,000 part of an inch.

They are inspected at the end of each manufacturing process, so we know how well made they are.

Perhaps we can help you cut operating costs and reduce loss of power through friction. Let us consult with your engineers. We have a vast amount of data on this subject which should be invaluable to you. No obligation.

Double-acting thrust bearing, flat seats (grooved races) 2100-F Series

Single-acting thrust bearing, flat seats (grooved races) 1100-F Series

Single-acting, self-aligning thrust bearing 1100 Series

Single-acting, self-aligning thrust bearing, leveling washer, 1100-U Series

Double-acting, self-aligning thrust bearing, leveling washers 2100-U Series

Single-row deep-groove Standard type, radial bearing

Double-row, deep-groove Standard type, radial bearing

Angular contact bearing, combination radial and thrust

Double-row, maximum type, radial bearing

Single-row, maximum type, radial bearing

Strom BALL BEARINGS

Manufactured by

STROM BALL BEARING MFG. CO.

Formerly U. S. Ball Bearing Mfg. Co.

4563 Palmer Street, Chicago, Ill.

Broadcasting
The World's New Drilling Record
Across the
every drill
this

AT the rate of 116 inches per minute through CAST IRON, and 50 inches per minute through MACHINERY STEEL—

This is the NEW world's drilling record established by

CLE-FORGE HIGH SPEED DRILLS
TRADE MARK REG. U.S. PAT. OFF.

at the Convention of the American Railway Association, Mechanical Division (Master Mechanics and Master Car Builders), in Atlantic City, during the week of June 11-18, 1924.

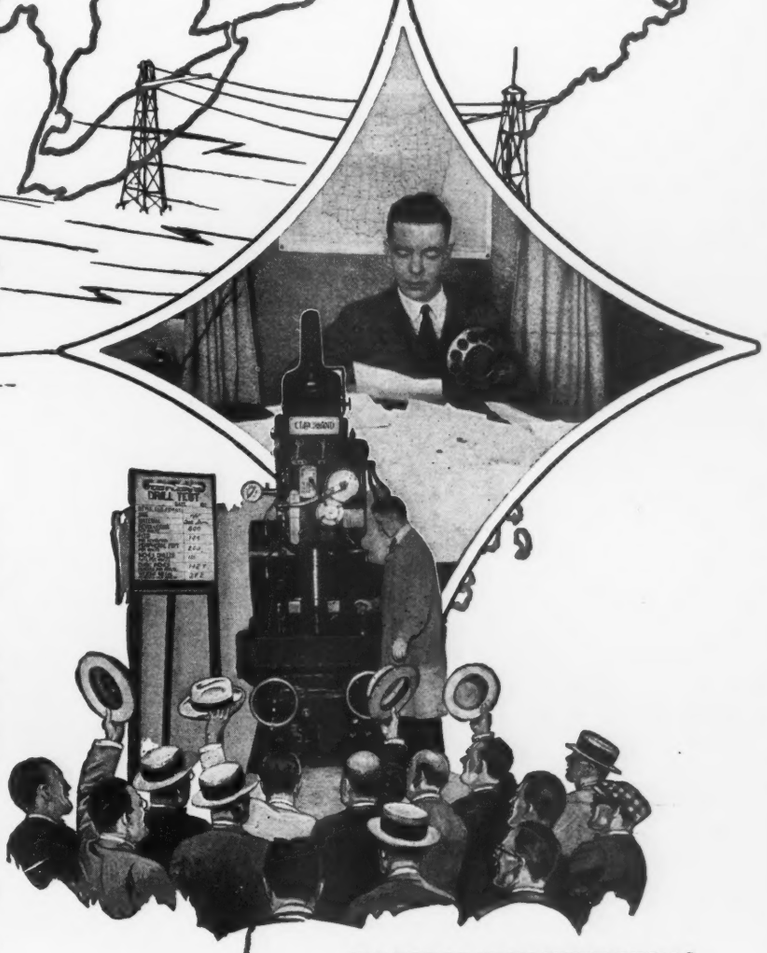
For the SECOND consecutive year, CLE-FORGE HIGH SPEED DRILLS have demonstrated their supreme strength and cutting qualities in a gruelling public test.

Records of unusual performance by CLE-FORGE

CLE-FORGE—The World's Record Drill

A CLE-FORGE Goal—No Wasted Hole

country to press comes message



HIGH SPEED DRILLS are not confined, however, to public demonstrations of this nature. In many plants, throughout the country, they are producing more and better holes than was possible until their introduction.

Here, we learn of a 43% reduction in hole production costs on steering knuckles. There, a shop started to use CLE-FORGE and increased hole production in cast iron flanges by more than 27%. A third saved nearly $5,000 a year. Still another, using CLE-FORGE, put into the bank the neat sum of $19,343.50.

There are sound economic reasons why you should use CLE-FORGE HIGH SPEED DRILLS. There are sound mechanical reasons. There are still sounder financial reasons.

Why not let CLE-FORGE *"tell their own story?"*

CLE-FORGE HIGH SPEED DRILLS establishing the new world's drilling record at the Convention of the American Railway Association, Mechanical Division, in Atlantic City, June 11-18, 1924.

The CLEVELAND TWIST DRILL COMPANY CLEVELAND NEW YORK-CHICAGO-LONDON

TRADE MARK REG. U. S. PAT. OFF. AND FOREIGN COUNTRIES

Twenty Years Ago—and Always

GEO MET RIC

Right on the Lead

Because Geometrics Last Out

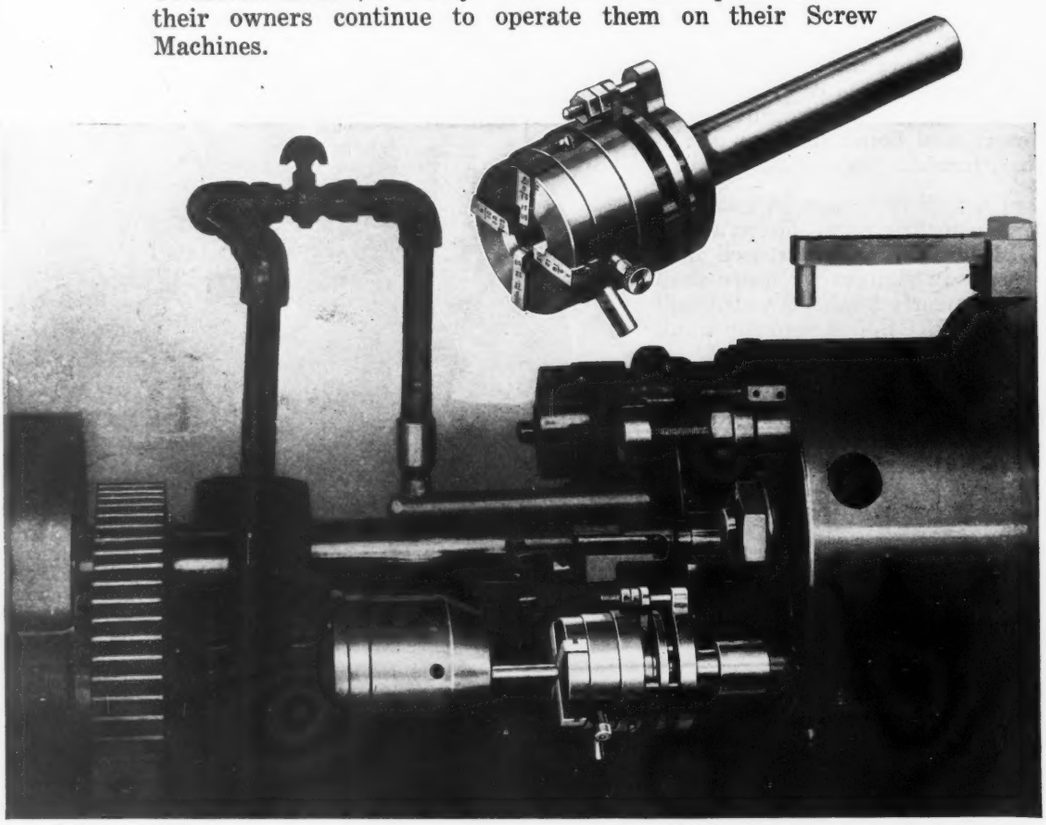
You are offered a Geometric Thread Cutting Tool on Thirty Days' Trial.

Perhaps you will ask, "What tools would not show up well for the first thirty days?"

We can name you Geometric Tools that have shown up well for Twenty Years.

Thread Chasers are being ordered today for use in Geometric Die-heads and Collapsing Taps that were installed twenty years or more ago.

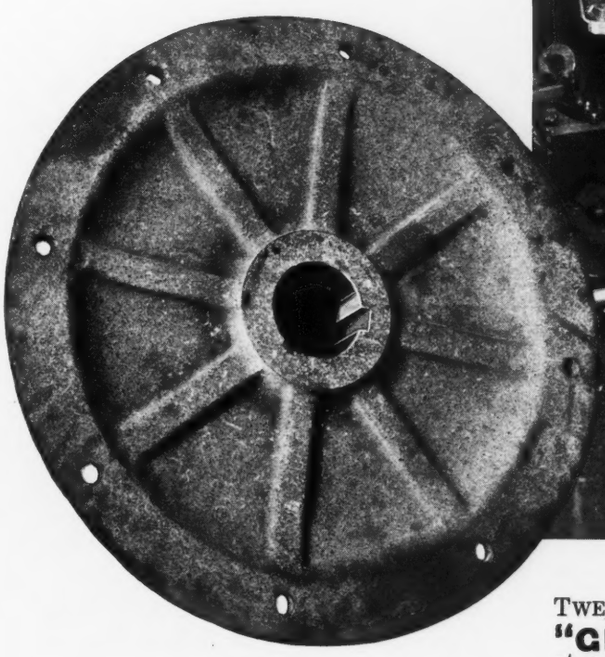
There is a standing offer to exchange these tools for the latest Geometric models, but they continue to stand up so well that their owners continue to operate them on their Screw Machines.



THE GEOMETRIC TOOL COMPANY

NEW HAVEN, CONN., U. S. A.

This "GIANT" KEYSEATER takes on all comers!



TWENTY-ONE YEARS of strenuous service—and this **"GIANT"** Keyseater still holds its own against any standard machine on the market. This old-timer, with another **"GIANT"** of recent design, cuts *all* the internal keyways on parts for oil-well machinery and equipment made in this plant.

The operation shown—cutting a keyway 1" wide by ½" deep and 4¾" long in cast-iron flanges, takes only three minutes—a striking example of the convenience of setting up on this machine, the work is simply placed on the post, it supports itself by its hub. The location of the keyway to the bolt holes is secured by the locating stud attached to the strap on the table. The stroke is easily and quickly set, the tool bar is supported by the post and cannot spring.

Quick, accurate work at low production cost; long service with minimum charges for upkeep and repairs; these advantages make **"GIANT"** Keyseaters profitable equipment everywhere.

Eight sizes—ask us about them

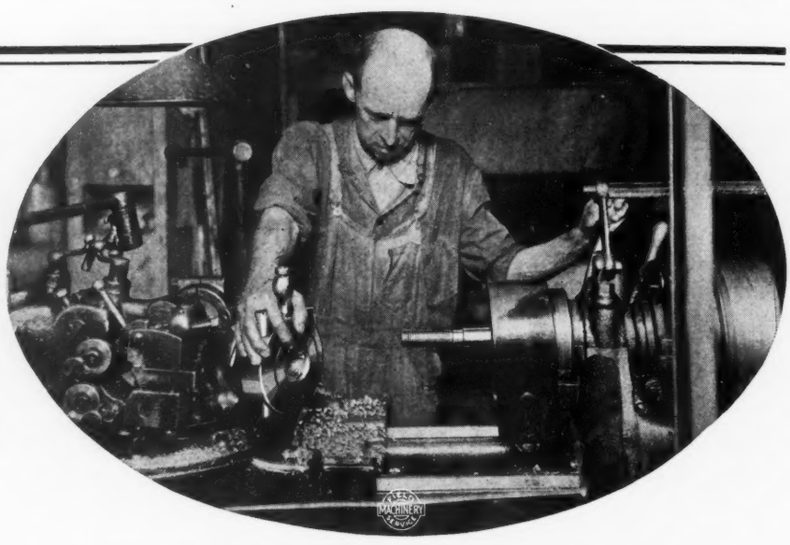
MITTS & MERRILL

843 Water St.,

SAGINAW MICHIGAN

FOREIGN AGENTS: Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. V. Lowener, Christiania, Norway and Stockholm, Sweden.

Use Hartness Self-opening Die-Heads on Your Turret Lathes



The Brownell Company of Dayton, Ohio, finds that with this Hartness Die Head only one cut is required to complete each thread on valve rods for 18″ by 24″ steam engines.

The rods are 14½″ long, the threads 1⅛″ diameter, 7 threads per inch—one 3″ and the other 2″ long. The foreman can't remember when Hartness Die-heads were not used for threading in this shop—and he has been there a good many years.

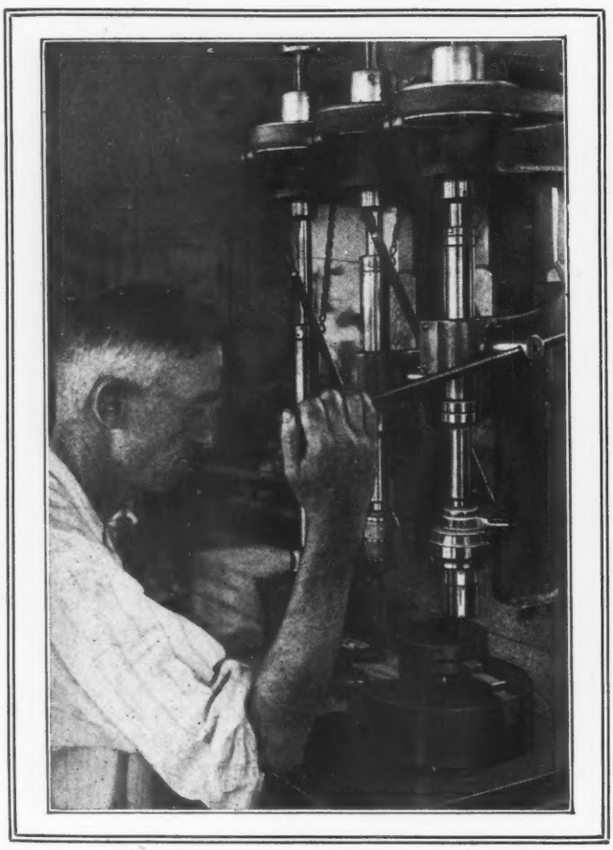
Let us show you why customers use Hartness Die-heads year after year, without thought of change. Write us.

JONES & LAMSON MACHINE COMPANY

DIE DIVISION

Springfield **Vermont, U. S. A.**

503 Market St., San Francisco, Cal.
9-10 Water Lane, Queen Victoria St., London, Eng.
Henry Coe & Clerici, Milano, Italy.



A Trail of Perfect Satisfaction Across the Continent

Users of Jarvis Production Tapping Equipment report its efficiency from widely scattered plants.

"Our Jarvis Tapper surely is a 100% tool, doing wonderful work in die castings." *This from California.*

"None can compare in performance with the Jarvis. It is invaluable on our class of work." *That from New York.*

Seven sizes of Jarvis High Speed Tapping Devices are maintaining their reputation on a range of tapping from 0 to 2″ diameter inclusive.

The cut shows the Jarvis High Speed Tapping Device with ball drive and ball reverse. Extremely sensitive in action it reduces tap breakage and increases production wherever it is used.

Send for details of Jarvis Tapping equipment.

The Geometric Tool Co.

SOLE DISTRIBUTORS

NEW HAVEN, CONN., U. S. A.

ARMSTRONG
TRADE MARK REG. IN U.S. PAT. OFFICE

TOOL HOLDERS

"Armstrong" means "Tool Holder" in the machinist's world—you can't say the one without thinking the other. And this is as it should be—for Armstrong developed the Tool Holder and for more than thirty years has been making the best Tool Holders that knowledge of requirements and experience can produce.

Armstrong Tool Holders save all the forging time, save 70% of the grinding time, save 90% of the investment in tool steel. These are facts—not claims. We can prove them.

Send for a copy of the new Armstrong catalog—complete line—Lathe Tools, Clamps, Dogs, Pipe Tools, Ratchets, Wrenches.

POINTS OF ADVANTAGE

PROJECTING SUPPORT UNDER CUTTER prevents chatter and breaking of cutters.

MAXIMUM CLEARANCE—Beveled front end is very helpful in close quarters.

OVERSIZE CUTTER AND HEAD—Give strength and increased capacity.

PATENT STOP FOR CUTTER prevents cutter from dropping out from rear end of socket.

EXTRA LARGE SCREW—Alloy steel, heat-treated, practically unbreakable.

SHANK, IMPROVED DESIGN—Heat-treated, hardened. Outworks and outwears any imitation.

ARMSTRONG BROS. TOOL CO.

"THE TOOL HOLDER PEOPLE"

313 N. FRANCISCO AVE. CHICAGO, U.S.A.

There's *More Money* in Crushed Chips

Mills and brokers are ready to pay $2.00 to $3.00 more per ton for fine crushed "shoveling" turnings, than for the long, loose, bushy stuff as it comes from the tools.

Crushed turnings need only a fraction of the storage space—they lose almost nothing by rusting in storage—they melt down with less burning—they yield more oil.

Three or four times as many crushed turnings can be loaded in a car or truck—and they can be loaded by grab buckets or mechanical loaders—this means freight and labor saved.

To get **all** your money out of your turnings, equip your plant with the

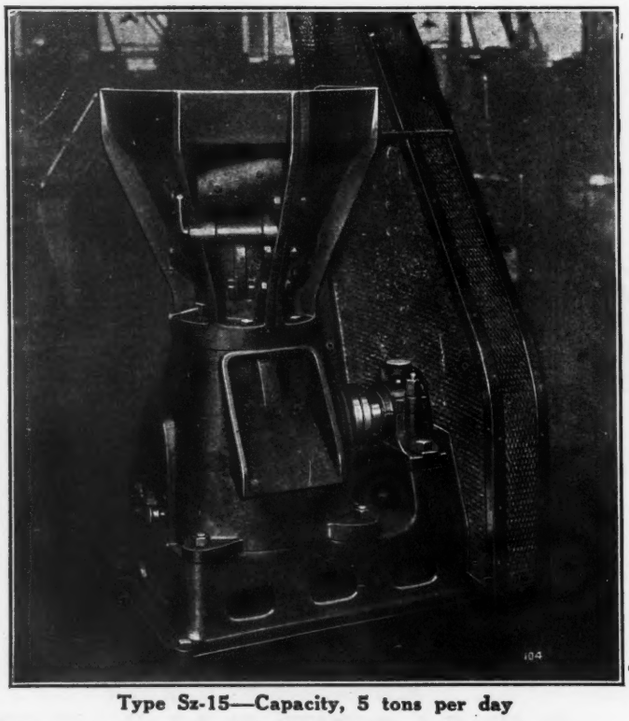
Turns a Scrap Nuisance into a real Source of Profit.

AMERICAN CHIP CRUSHER

Quickly Pays for Itself in the Savings It Effects

It is a compact, self-contained, powerful, low-speed machine designed for this special duty. And its success and economy have been proved in hundreds of installations. Two sizes—5 tons per day, needing only 4 H.P.—and 5 tons per hour, needing only 15 H.P. The operating and upkeep costs are negligible compared with the savings effected. In fact, the American Chip Crusher pays for itself in a few months, in the average plant. It needs no extra labor—usually the man looking after the oil separators can also run the crusher. Its savings are almost clear profit.

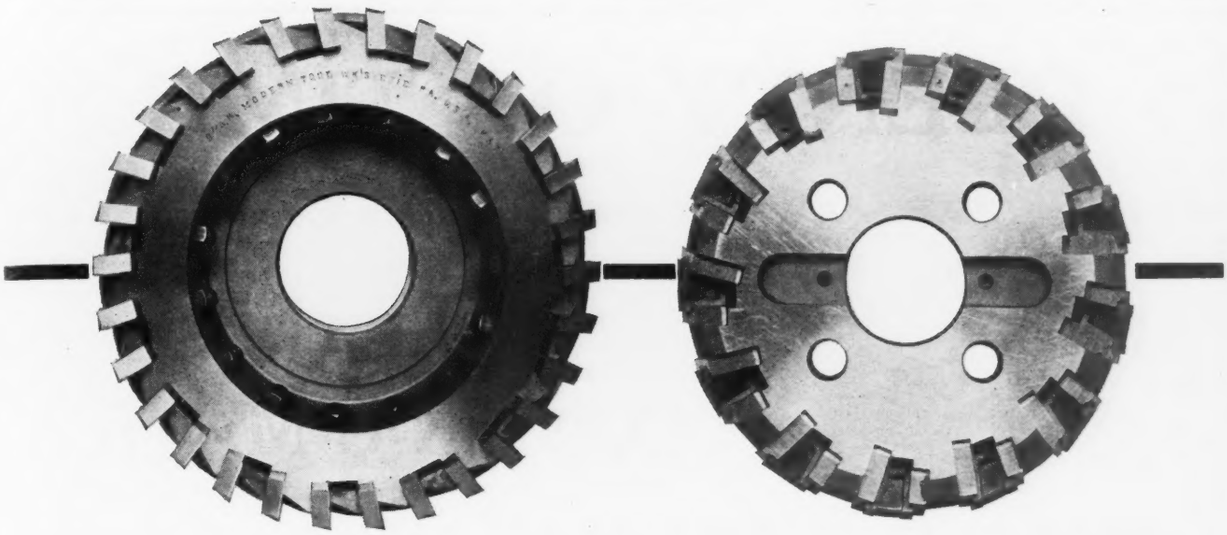
Let us send you more complete details. Write us, telling what kind and how many turnings you have. We will make suggestions and quote prices.



Type Sz-15—Capacity, 5 tons per day

AMERICAN CRUSHER AND MACHINERY CORP.

ONE MADISON AVENUE, NEW YORK, U.S.A.



Modern Inserted Tooth Face Milling Cutters

The body is made from hammered steel forging hardened and ground. By the use of the taper wedge the narrow slot is eliminated not only showing a saving in fitting new blades but in adjusting blades for regrinding. Each blade has a series of notches which fit over a stop pin in the head. This not only backs up the blade but for regrinding each blade is advanced one notch which brings them all out exactly the same distance. Made in sizes from 4″ to 16″ in fine and coarse pitch—other sizes on request. Send for Bulletin M-61.

MODERN TOOL WORKS, Erie, Pa., U. S. A.

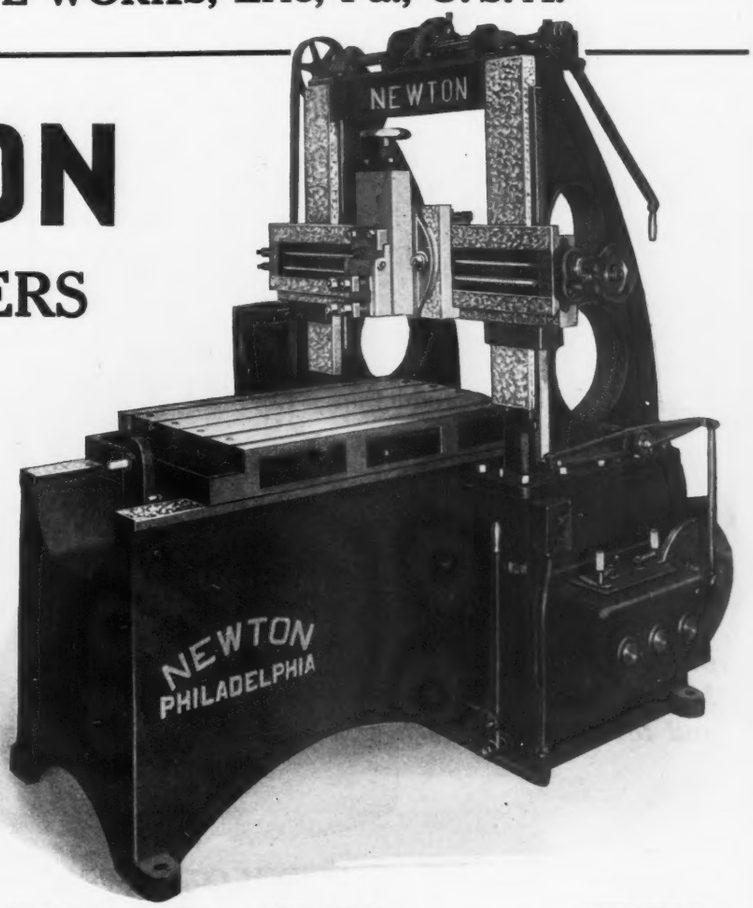
NEWTON

TRADE MARK REGISTERED

CRANK PLANERS

This sturdy machine is built in two sizes having a maximum stroke of 34″ and 39½″.

They are capable of doing all work usually done on a shaper and all short stroke planer jobs more efficiently and economically. They are worth investigation and details will be gladly furnished on request.



NEWTON
MACHINE TOOL WORKS
PHILADELPHIA, PA.
OF THE
CONSOLIDATED MACHINE TOOL
CORPORATION OF AMERICA
MAIN OFFICE: WILMINGTON, DEL.

BETTS Rochester
Engine Lathes
Boring Mills
Planers
Slotters
Axle Lathes, Etc.

COLBURN Rochester
Drill Presses
Special Drills
H. D. Boring Mills
Standard Boring Mills
Rod Boring Machines

HILLES & JONES Wilmington, Del.
Punches and Shears
Bending Rolls
Plate Planers
Flanging Clamps
Straightening Rolls, Etc.

MODERN Erie, Pa.
Plain and Univ. Grinders
Threading Machines
Self-opening Dies and Taps
Magic Chucks and Stud Setters
Insert. Tooth Face Mill Cutters

NEWTON Philadelphia
Cold Saws
Crank Planers
Milling Machines
Rod Borers
Cylinder Borers, Etc.

PLENTY OF TIME

to produce a Good Job

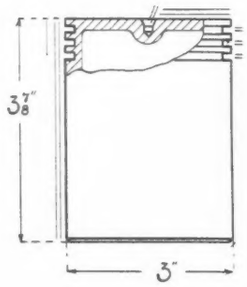
on a

BULLARD CONTIN-U-MATIC

But—

Divide that time by Six to equal actual production time

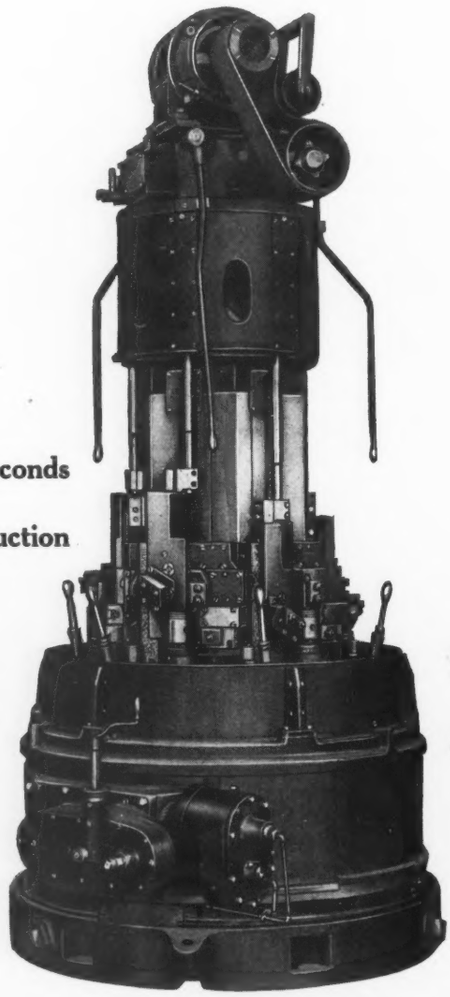
CONTINUOUS—
UNINTERRUPTED



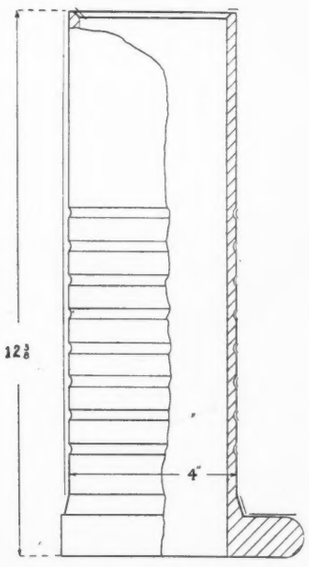
2 Min. 13 Sec. / 6 = 22 Seconds

22 Seconds Unit Production

Actual machining time allows for proper finishing—Maintenance of sizes and tools.



10 INCH CONTIN-U-MATIC



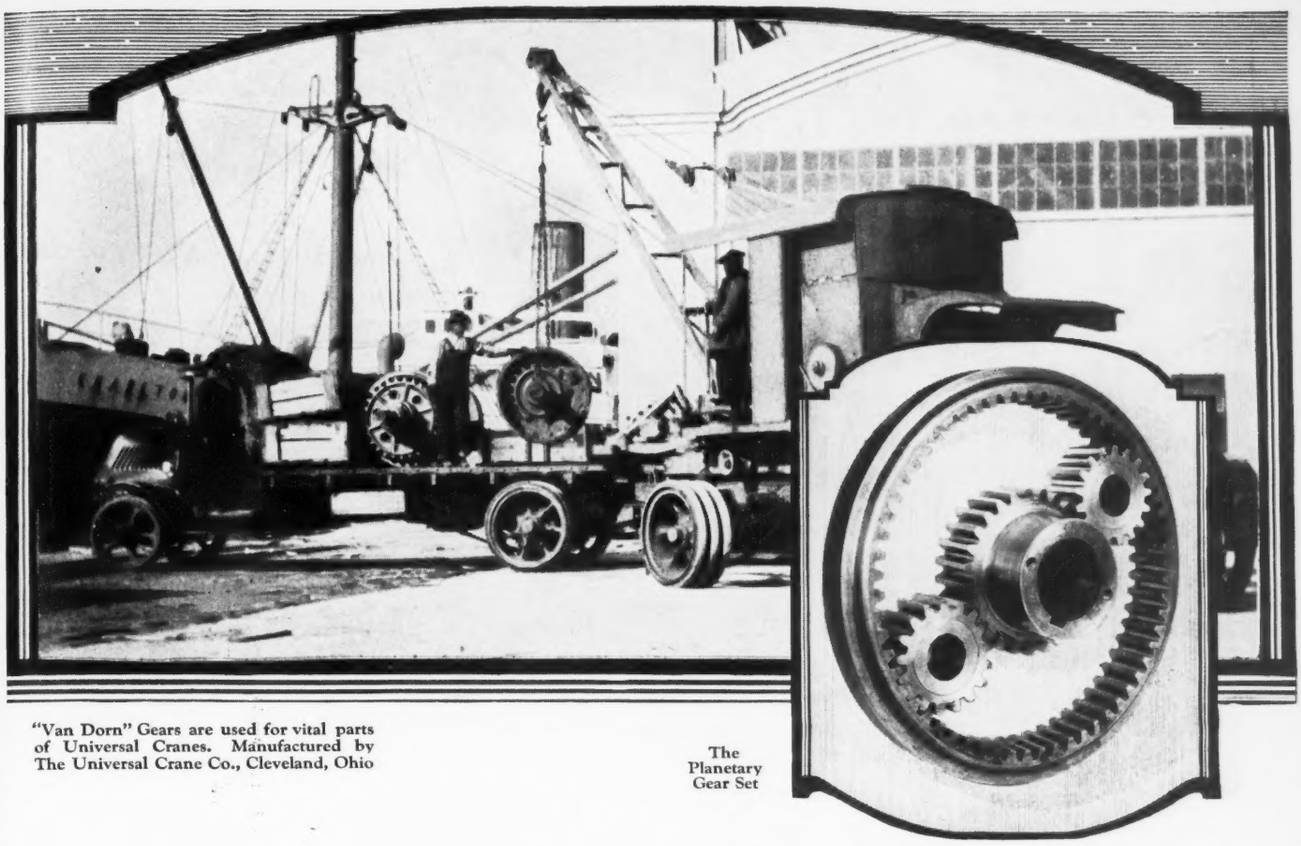
3 Min. 9 Sec. / 6 = 31.5 Seconds

31.5 Seconds Unit Production

One operator—Six machine production from the floor space of one.

THE BULLARD MACHINE TOOL COMPANY

BRIDGEPORT CONNECTICUT



"Van Dorn" Gears are used for vital parts of Universal Cranes. Manufactured by The Universal Crane Co., Cleveland, Ohio

The Planetary Gear Set

Better Cranes With "Van Dorn" Gears

From no load to full load—INSTANTLY. That severe strain is just one of the many important functions that "Van Dorn" Gears perform in the operation of Universal Cranes.

The planetary gear set used to drive and control the hoist drum must be well made, carefully cut, and accurately fitted to run quietly and insure uniform operation. Gears for swinging the crane, for raising and lowering the boom, and for handling heavy loads must likewise be of the highest quality and as nearly abuse proof as possible —

For everyone knows that Universal Cranes used in building and highway construction, for railroad service, for loading and unloading operations in many industries are given anything but gentle handling.

By preventing breakdowns, accidents and expensive delays, "Van Dorn" Gears are pinch hitters in hundreds of industries. Possibly you have a gear problem that our experienced engineers can help you solve.

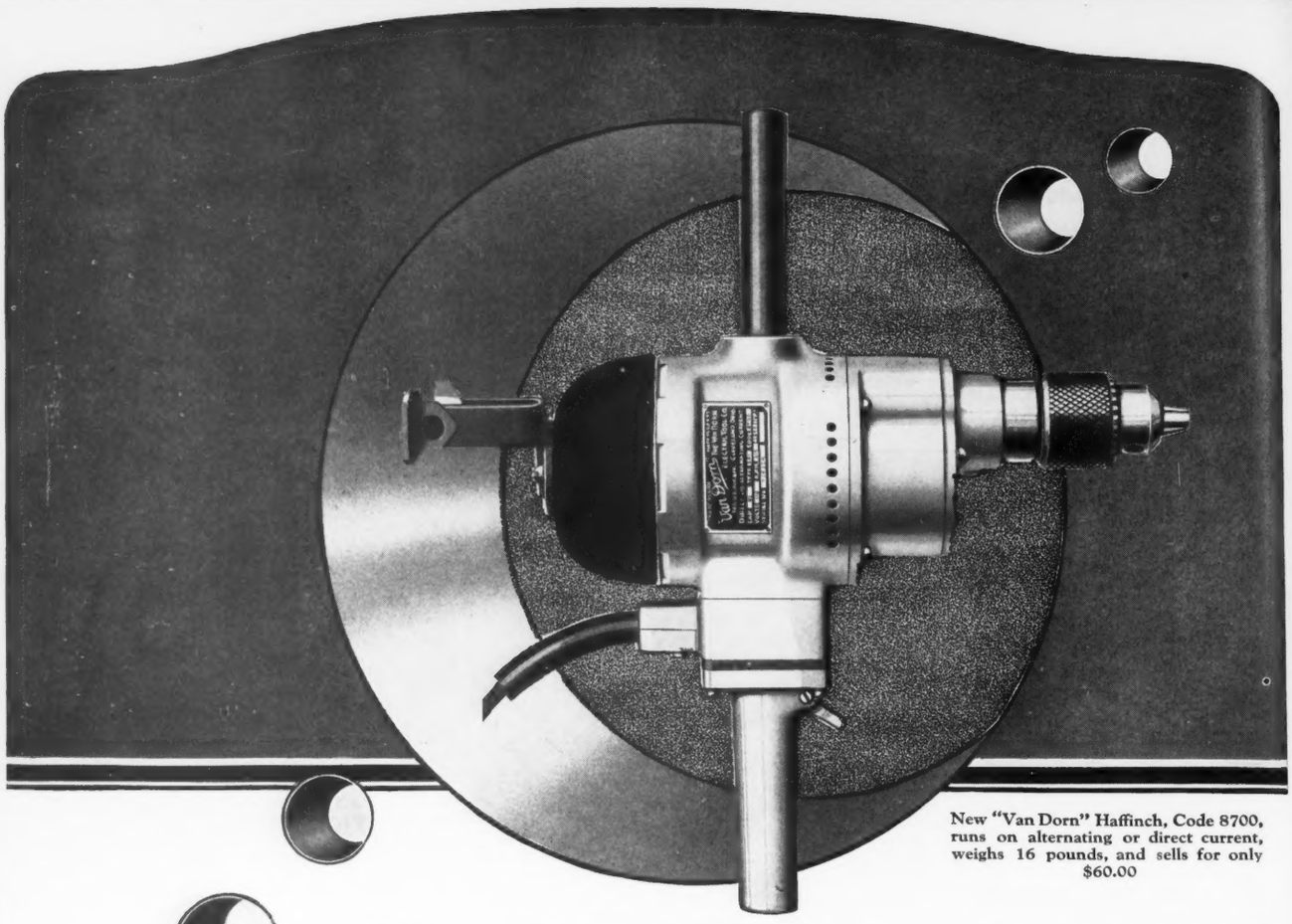
The Van Dorn & Dutton Company

Gear Craftsmen for Over a Quarter Century

Cleveland, Ohio

"Van Dorn" GEARS

MEMBER OF AGMA



New "Van Dorn" Haffinch, Code 8700, runs on alternating or direct current, weighs 16 pounds, and sells for only $60.00

"Van Dorn" Haffinch—the Drill of a Thousand Uses—and *Only* $60.00

For the first time in the history of electric tools, you are enabled to purchase a half inch portable electric drill of "Van Dorn" quality at a price so reasonable—$60.00.

Haffinch delivers more "power per pound" than any electric drill heretofore produced:—It stands heavy duty or light duty—drills through toughest steel or softest wood—makes one hole or a million—works one hour or twenty-four hours—and doesn't need a rest every half hour either.

Haffinch is the drill of a thousand uses for production or maintenance work in plants and service stations everywhere:—For automotive and parts manufacturers—for woodworking operations—for many classes of railway construction—for hurry-up holes around the mines—for office buildings, hotels—an almost endless list.

A time-saver and money-maker in your business. Give us a call and let us demonstrate.

The Van Dorn Electric Tool Co.

Makers of Portable Electric Drilling, Reaming and Grinding Machines, etc.

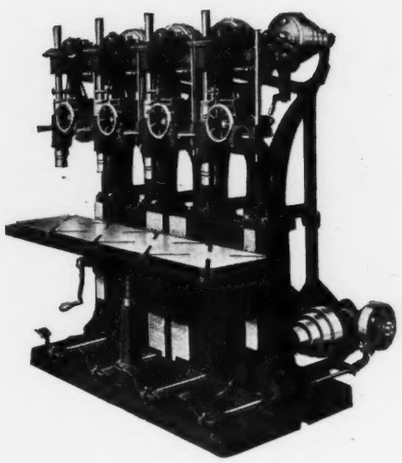
Cleveland, Ohio

Factory Representatives

*Boston
Buffalo
Chattanooga
*Chicago
*Cincinnati
*Denver
*Detroit
Kansas City
*Los Angeles
Montreal
*New York City
Philadelphia
Pittsburgh
Richmond
*St. Louis
St. Paul
*San Francisco
*Seattle
*Toronto

*Service

"Van Dorn" ELECTRIC DRILLS



WE MANUFACTURE a complete line of upright drilling machinery, both stationary and sliding head, column and bench friction types.

Sizes range from 8-in. to 50-in. swing, and can be arranged for belted or geared motor drive, tapping attachment, lubricating system for cooling the drill, right angle drive, round, square, or compound table.

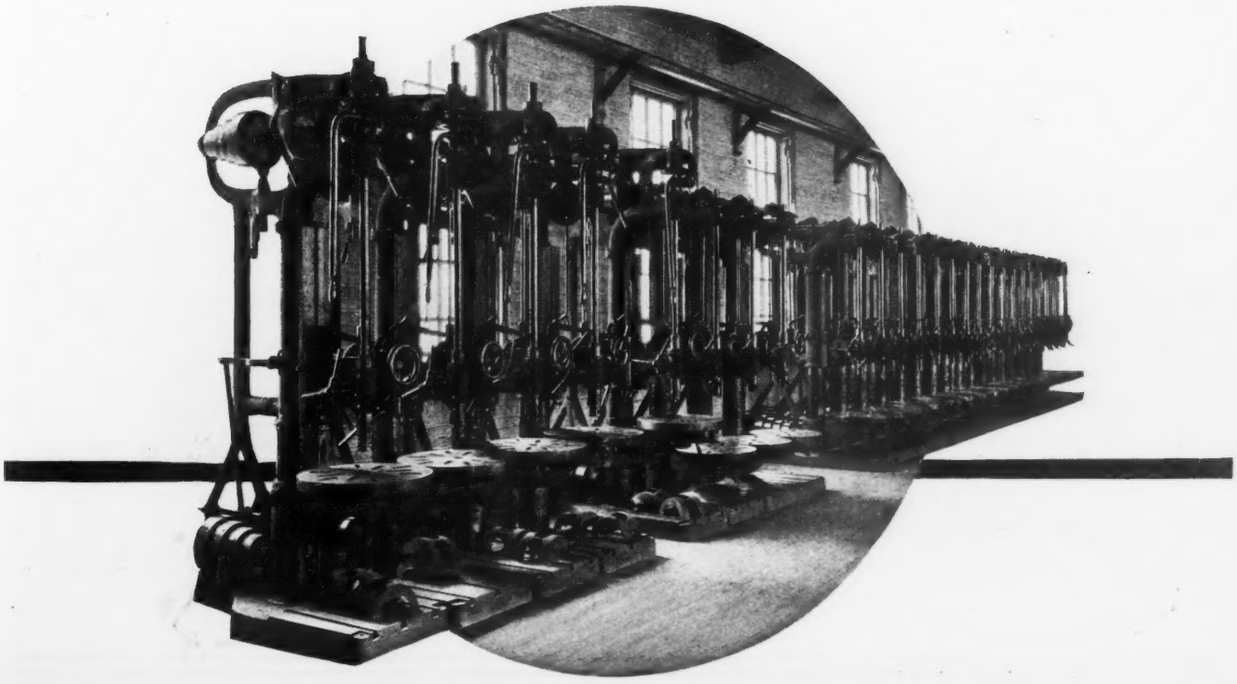
Also gang drills in any combination to meet your requirements can be shipped on very short notice, as all units for these gangs are always carried in stock.

"Barnes"

W. F. & John Barnes Co.

Rockford, Illinois

Builders of Barnes Drills Since 1878



The New Cleveland Multiple Spindle Automatic

Some Production Figures—

No. 1—Length 4 15/16". Largest diameter 7/8".
Production: 300 per hour—brass
128 per hour—steel

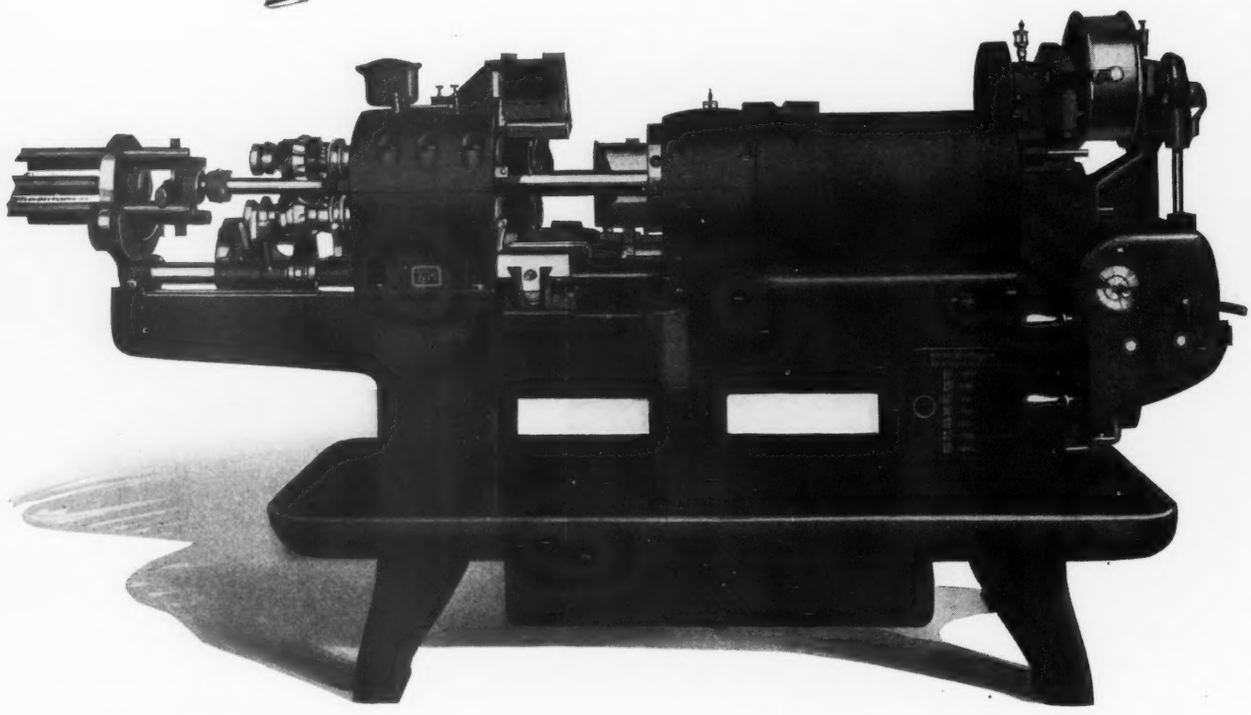
No. 2—Length 1 7/8". Largest diameter 1/2".
Production: 450 per hour—brass

No. 3—Length 3 3/8". Largest diameter 5/8".
Production: 200 per hour—steel

That's what the New Cleveland Multiple Spindle Automatic will do on work of this character—figures are guaranteed. The new machine complements, but does not supplant the Cleveland Single Spindle Automatic. For certain work—second operations, work beyond the capacity of the new machine, this remains indispensable.

The Multiple Spindle Cleveland is built on the lines that make the Cleveland Single Spindle Machine so efficient. Controls are the same and all auxiliary tooling equipment with the exception of threading tools is interchangeable.

Cleveland Automatic equipment is now complete. Write for estimates on your work.

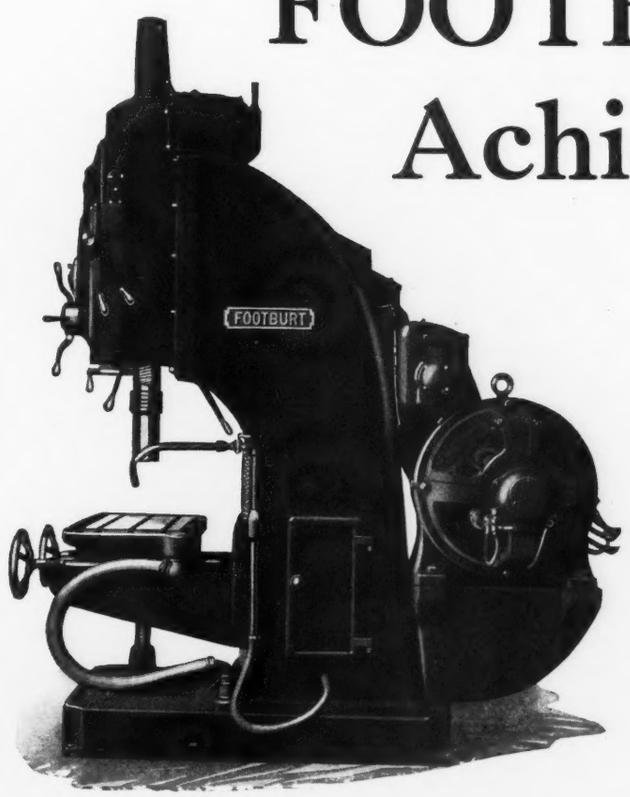


1/32 TO 3/8 18 FEED CLEVELAND'S APACITY UNEQUALED

The Cleveland Automatic Machine Co.
CLEVELAND, OHIO

FOOTBURT

Another FOOTBURT Achievement



FOOTBURT machine smashes world's drilling records

New world's drilling records made on this machine

Official records made with Cleveland Twist Drills at the Convention of the American Railway Association, Mechanical Division, in Atlantic City, June 11-18, 1924.

Size Drill	Thickness Material	Rev. per Min.	Feed per Rev.	Peripheral Feet Per Min.	Inches Drilled Rate per Min.	Weight Metal Removed Per Min.
		CAST IRON				
1¼″	3 ″	800	.145	260	116″	37.2 lb.
1 ″	2½″	800	.145	210	116″	23.8 lb.
		MACHINERY STEEL				
1 ″	2 ″	615	.0815	161	50″	11.2 lb.
1¼″	2 ″	550	.0815	180	44.8″	15.6 lb.

THE FOOTE-BURT COMPANY
Cleveland, Ohio

DETROIT OFFICE
4-151 General Motors Bldg.

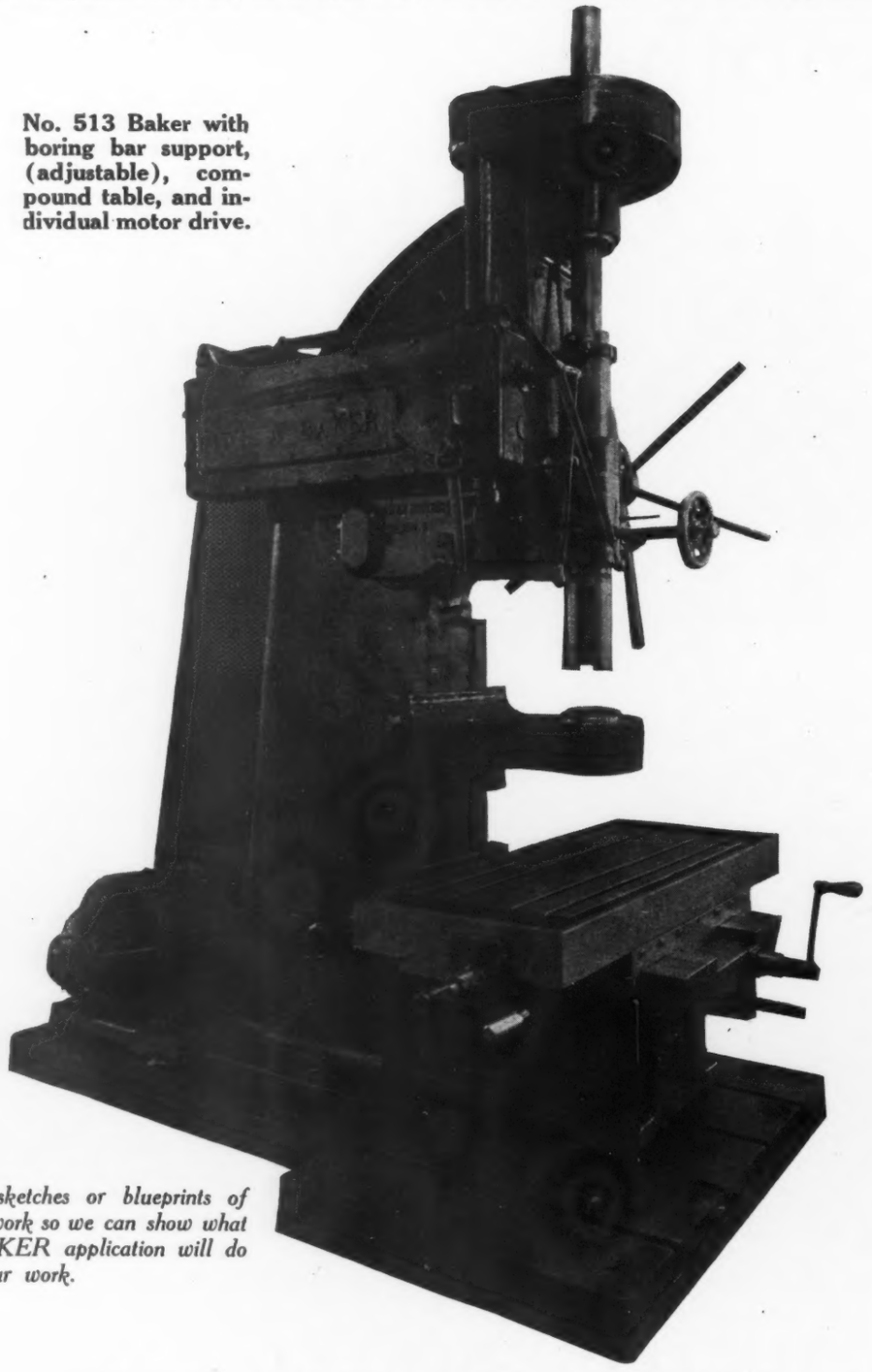
MILWAUKEE OFFICE
1143 Wells Bldg.

FOOTBURT

BAKER DRILLS

FOR DRILLING, BORING, TAPPING, FACING, ETC.

No. 513 Baker with boring bar support, (adjustable), compound table, and individual motor drive.



Send sketches or blueprints of your work so we can show what a BAKER application will do on your work.

Do you realize the possibilities of BAKER machines on boring, tapping, drilling and facing operations? They are made in a wide range of sizes and types, from universal machines for miscellaneous work to highly specialized production equipment.

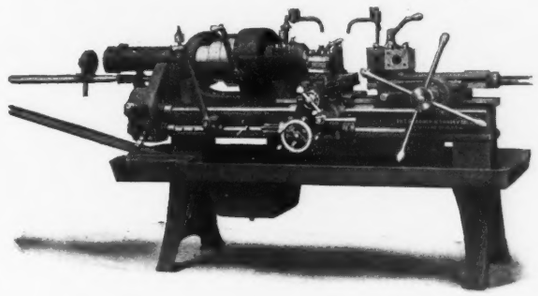
BAKER BROTHERS, Inc., Toledo, Ohio

Warner & Swasey Turret Lathes

Used to finish locomotive and car parts—automobile and engine parts—plumbing and glass-mould parts. In fact there is hardly an industry which has not benefited by the use of turret lathes.

Rapid and accurate production of pins, gears, hubs, spindles, valves, bottle and electric light moulds are some of the parts finished profitably on Warner & Swasey Turret Lathes.

W & S Turret Lathes are built in several sizes, from $\frac{5}{8}$" x 4" bar capacity, 10" swing, to $4\frac{1}{2}$" x 44" bar capacity, $21\frac{1}{2}$" swing.



No. 4 Universal Turret Lathe: Bar Equipment
Capacity—$1\frac{1}{2}$" x 10", 16" swing

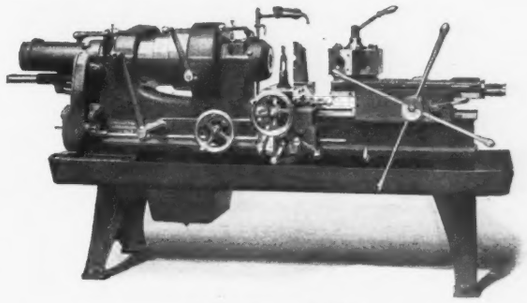
Universal Hollow Hexagon Turret Lathes: Nos. 2-A and 3-A, the larger machines built by The Warner & Swasey Company, are easy to operate, and they produce rapidly and accurately. In other words, they are dividend earning investments.

A square and a hexagon turret provide ten tool positions for each set-up. This often enables the machine to finish parts in one chucking which otherwise would require two or more chuckings or tool set-ups.

Each turret carriage has twelve power feeds, in either direction, and each turret operates independently. The two turrets are operated simultaneously on much of the work.

Bar and Chucking Work are done with equal efficiency.

No. 4 Universal Turret Lathes are similar to the larger 2-A and 3-A Machines. Being a smaller machine, it is more easily and quickly operated and therefore more profitable on smaller work.



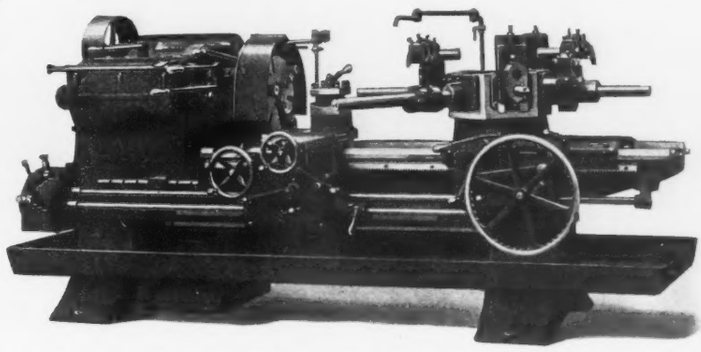
No. 6 Turret Lathe
Capacity $2\frac{1}{4}$" x 12", $20\frac{3}{8}$" swing

No. 6 Turret Lathes are built very strong and powerful. It takes heavy turning, forming, boring and facing cuts with great accuracy.

The smaller turret lathes are built with the same careful selection of workmanship, material and design, although the work done on these smaller machines does not require the automatic features of the larger machines.

TURRET LATHE TOOLS:

A line of Turret Lathe Tools is maintained in stock. From long experience in designing and building special tools for turret lathes, the W & S Engineering Department has built up a line of standard tools which covers a wide range of work. *Send for a catalog.*



No. 3-A Universal Hollow-Hexagon Turret Lathe: Chucking Equipment
Two Capacities—$3\frac{1}{2}$" x 44", $21\frac{1}{2}$" swing; $4\frac{1}{2}$" x 44", $21\frac{1}{2}$" swing

The Warner & Swasey Company

Cleveland, U. S. A.

NEW YORK: Singer Building
CHICAGO: 618-622 Washington Boulevard
BOSTON: Oliver Building
MILWAUKEE: 1143 Wells Building
DAYTON: 518 Mutual Home Building
BUFFALO: Iroquois Building
DETROIT: 5928 Second Boulevard

You have a job for Haynes Stellite

THESE ARE the qualities of HAYNES STELLITE that make it indispensable to hundreds of manufacturers in the making of a range of products all the way from automobiles to ice-cream:

It is an intrinsically hard cast metal.

It requires no heat treatment.

Its temper is inherent and permanent.

It resists abrasion better than any other known metal.

It is not affected by heat up to 1500° F.

It is tougher at red heat than when it is cold.

It cannot rust or be corroded by any ordinary chemical or acid.

It is non-magnetic and does not adhere to other metals.

It takes a high, silver-white polish and retains it.

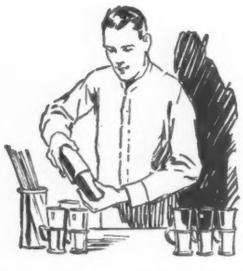
Haynes Stellite resists wear. Haynes Stellite gages outlast steel 400% to 600%. Lathe and grinder centers show equal increases in length of life.

Haynes Stellite does not adhere to other metals. It is used in burnishing gold and silver-leafed band instruments.

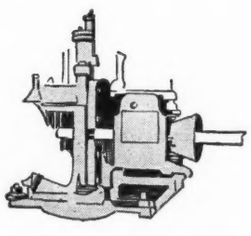
HAYNES STELLITE lathe and milling tools have proved themselves 30% to 100% more efficient in machining operations than tools of any other cutting metal. They have made themselves indispensable in large plants all over the world.

So diverse are its other uses that we lay this list of qualities before you, that you may profit, as others have, by your ingenuity in applying HAYNES STELLITE to specific operations.

Your letter to the nearest district sales office will bring you a prompt answer to any questions you may ask.



Haynes Stellite valves, used in the manufacture of ice-cream in quantity, resist the corrosive action of lactic acid and the erosion of terrific pressure.



Haynes Stellite, working under a continuous heat of 1400° F in a hot billet scraper, meets a test no other metal can pass.

Haynes Stellite can be deposited on other metals where a coating is sufficient. Cheaper dies with longer life are one such application.

HAYNES STELLITE

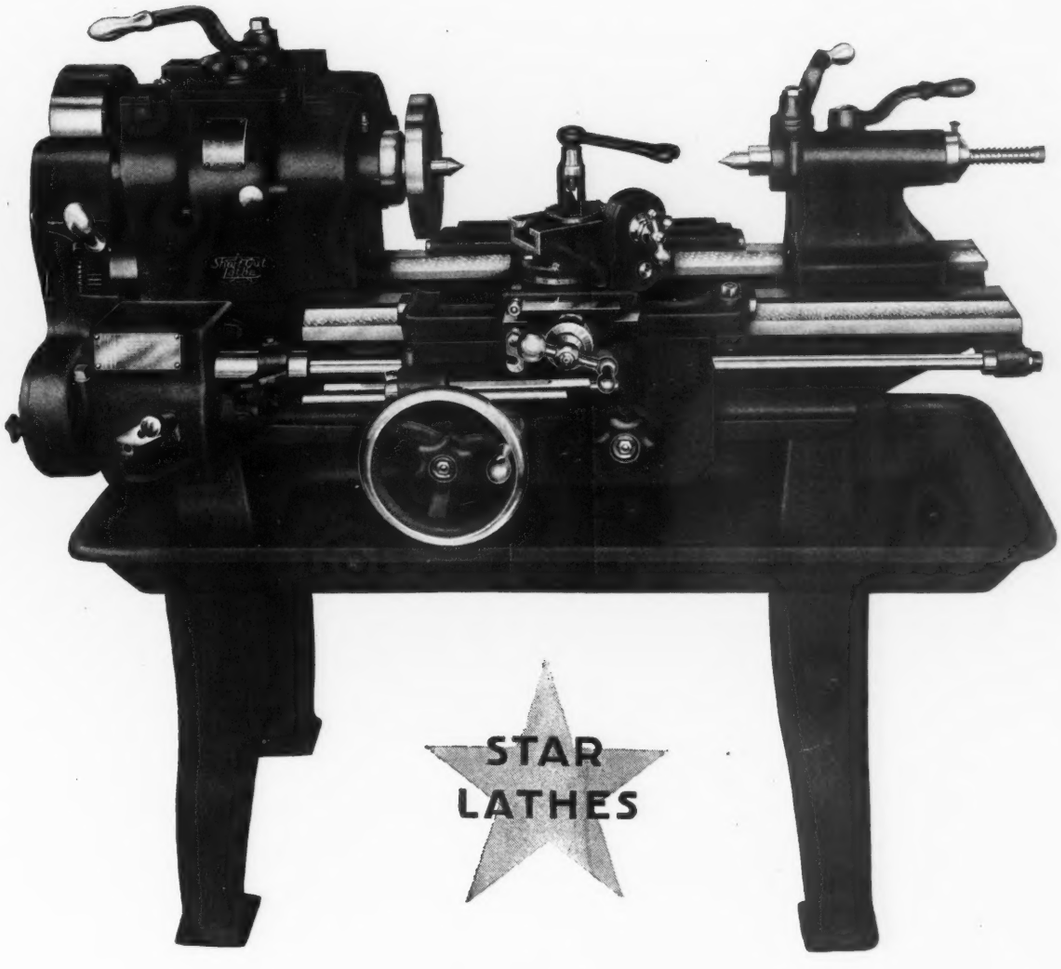
HAYNES STELLITE COMPANY

District Sales Offices

Carbide & Carbon Building, 30 East 42d Street, New York

People's Gas Building, Chicago 4503 Euclid Avenue, Cleveland General Motors Building, Detroit

"Short Cut" Lathes for Production



More than Half a Century Ago

More than half a century ago "Star" Lathes were marketed—designed for light manufacturing, educational and experimental work and repair work. They are and always have been 100% practical tools—without superfluous weight, useless parts or fancy trimmings. They are all lathe, every bit of them, and are recognized as such wherever lathes are known or used. If you have standard engine lathe work within their range you can fare no better than when you invest in "Star" Lathes.

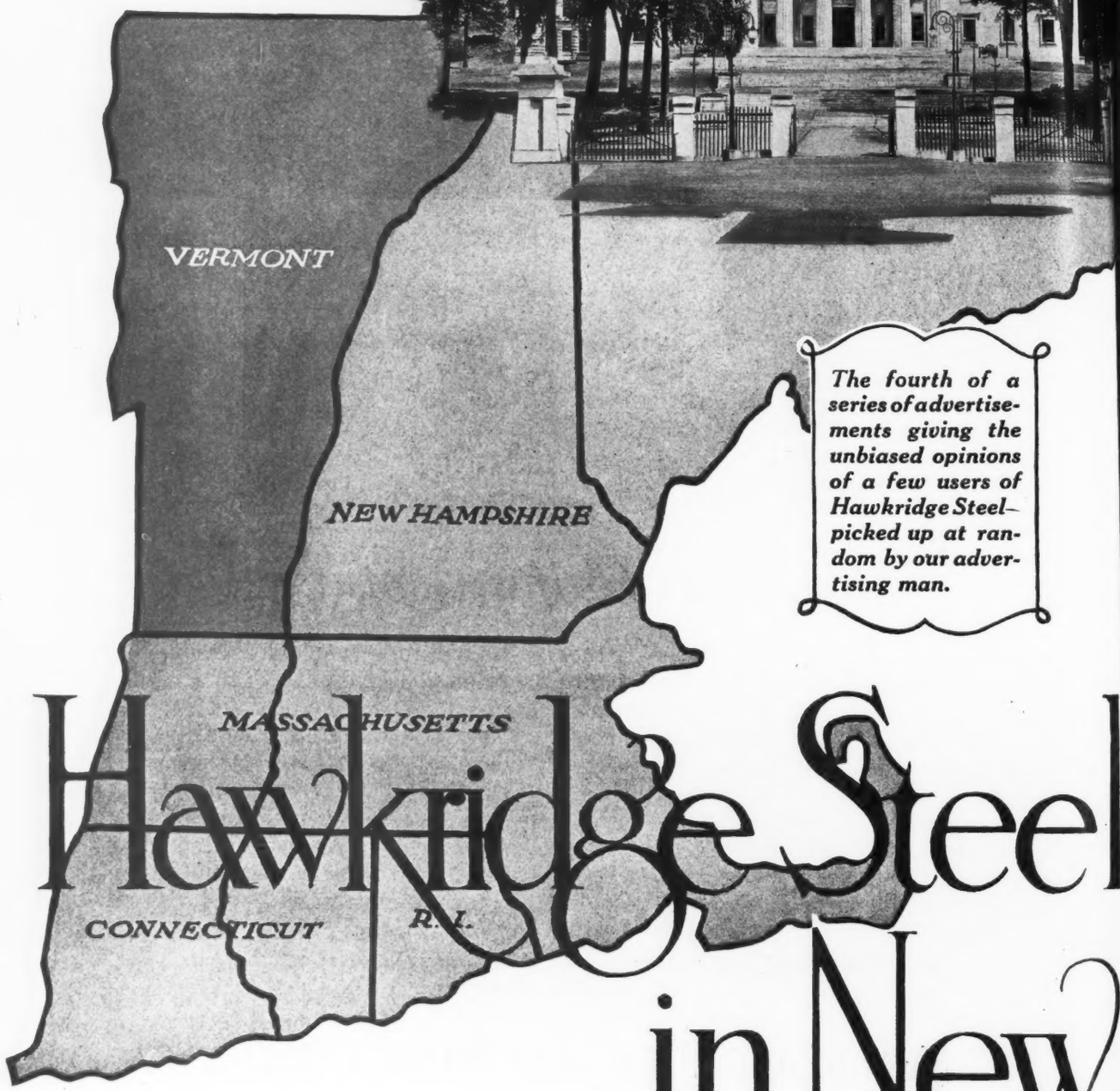
The "Short Cut" is a comparatively recent development—a production machine for small size work requiring heavy, multiple cuts. Performs the work of much larger machines at greatly reduced costs—faster, better and more economically than the machines it surplants.

You should know more about "Star" and "Short Cut" Lathes
Send for Bulletins

SENECA FALLS MACHINE COMPANY

Seneca Falls, N. Y., U. S. A.

If you are a New Englander and use Steel—you need Hawkridge.



The fourth of a series of advertisements giving the unbiased opinions of a few users of Hawkridge Steel—picked up at random by our advertising man.

Hawkridge Steels in New

The Ad Man Journeys Through the Green Mountain State

It was a case of "welcome on the mat" wherever the Ad man went in Vermont. Hawkridge customers are Hawkridge friends —everywhere.

As usual the Ad man's way led to all kinds of plants. He carried his inquiries from the shop building big machine tools to the factory devoted to delicate textile machinery; from the small-tool manufacturer's place to the shop turning out rugged, powerful stone working equipment; he found plants where such precision machines as delicate weighing scales were being produced—and everywhere he found Hawkridge Steel an essential factor in manufacturing, Hawkridge Service a recognized aid in securing steel to most profitably meet special needs.

They are hard workers in Vermont—and they are hard headed. When they find a product *right*—when they've proved its qualities—they *stick to it.* One of the Vermont machine tool builders, who has used Hawkridge Steels for more than 20 years, placed his first order as superintendent for another company; he's his own boss now—but he still buys Hawkridge Steel—a lot of it, too. There's special steel needed for the clutch parts and the special collets on his machine and the help given by the Hawkridge experts to this end is fully appreciated.

In a textile machine plant—everybody knows how *sure* you have to be on that sort of machinery, sure or sorry—not only the members of the firm and the superintendent, but the men in the shop lined up as rooters for Hawkridge Steel. It has been 25 years since the first Hawkridge order made good in that shop and the reorders have been constant ever since.

There is a particularly fine type of scale made "up in Vermont" in which Hawkridge Steels have been used for the past 34 years; principally the orders are for a special alloy developed for pivots and bearings—these parts are the "life" of the scale and it is significant that Hawkridge Steel is always specified to insure their utmost durability.

The Ad man called on a lot of people in Vermont; talked on a lot of different subjects; analyzed various propositions—always with steel as a basis. It would take too much space to set down all the interesting things he heard, but there was invariably an assurance—

that Hawkridge Steels stand up to their work,
that Hawkridge Service is ready to meet every need

HAWKRIDGE BROS. COMPANY
303 Congress Street
BOSTON 9, MASS.

Hawkridge Steels

IN STOCK

High Speed Steels
Machinery Steel
Crucible Tool Steel
Oil-hardened or Water-hardened
Hot-rolled or Cold Drawn
High Carbon or Low Carbon
Rough Turned or Drill Rod Finish
Heat-treated or Annealed
Alloyed or Plain Steel in Rounds, Squares, Hexagons, Octagons, Quarter-octagons and Special Shapes

England

BORDRILMIL

(Pronounced Bōr'drĭ-mĭl)

It Bores—It Drills—It Mills

Finished complete in two settings—Seven operations in the first—Ten in the Second

TRADEMARK (REGISTERED)

Photographs by courtesy of the SPEIDEL ELEVATOR CORPORATION, Reading, Pa.

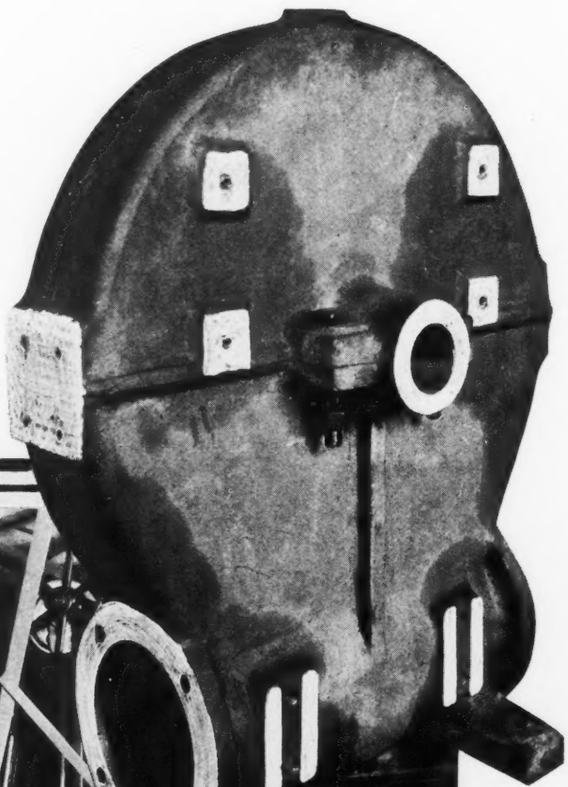
The lower picture shows a facing operation on the worm gear case of a five hundred pound capacity elevator. The insert illustrates the case for the largest of the Speidel line—six thousand pounds capacity.

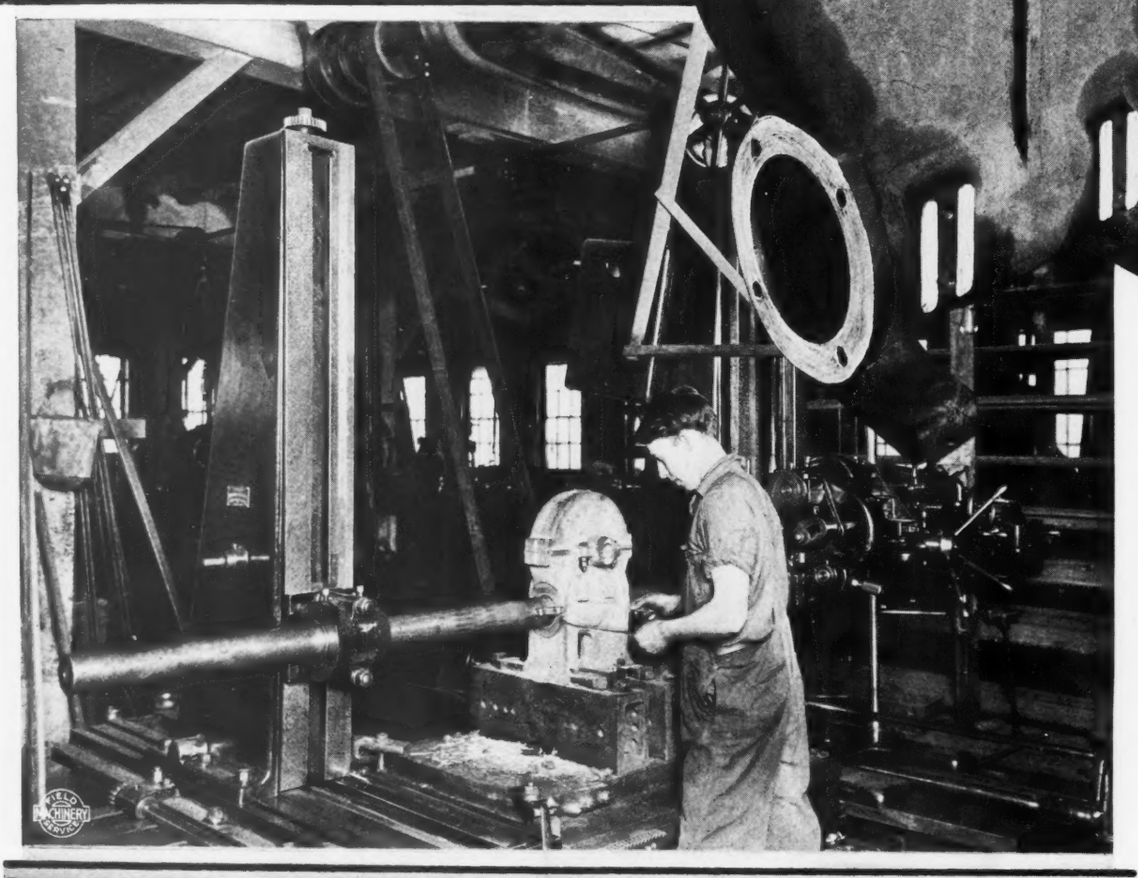
Admittedly the ideal machine for tool-room and job shop, a G&L BORDRILMIL when suitably tooled becomes a single function manufacturing tool, competitive in point of output with the single purpose machine, but without the latter's limitations in general usefulness.

Let our Production Service Department demonstrate that "You can do it better on a BORDRILMIL."

Giddings & Lewis Machine Tool Co.

Fond Du Lac **Wisconsin**





COLONIAL TOOL STEELS

Old Mother Hubbard's Tool Room

MEN who would not think of starting on a journey with only a spare car fare in their pockets, sometimes follow the policy of Old Mother Hubbard in stocking their tool rooms. A tool room bare of Tool Steel may mean a rush job delayed!

Colonial Warehouse and Mill deliveries are quick—notably quick; but in speed they cannot compete with your own well stocked tool room.

Like the spare tire on your car, spare Tool Steel on hand proves its greatest value when most urgently needed.

The Colonial brands that you use, the sizes that you wish, are likely at hand at the nearest Colonial Warehouse. But it is better by far to order this Tool Steel delivered to your tool room now, rather than to postpone action until a machine is idly waiting.

The Colonial salesman who visits your shop is an experienced man who can help you meet Tool Steel emergencies.

LIST OF TOOLS
and Grades of Colonial Steel adapted for their use

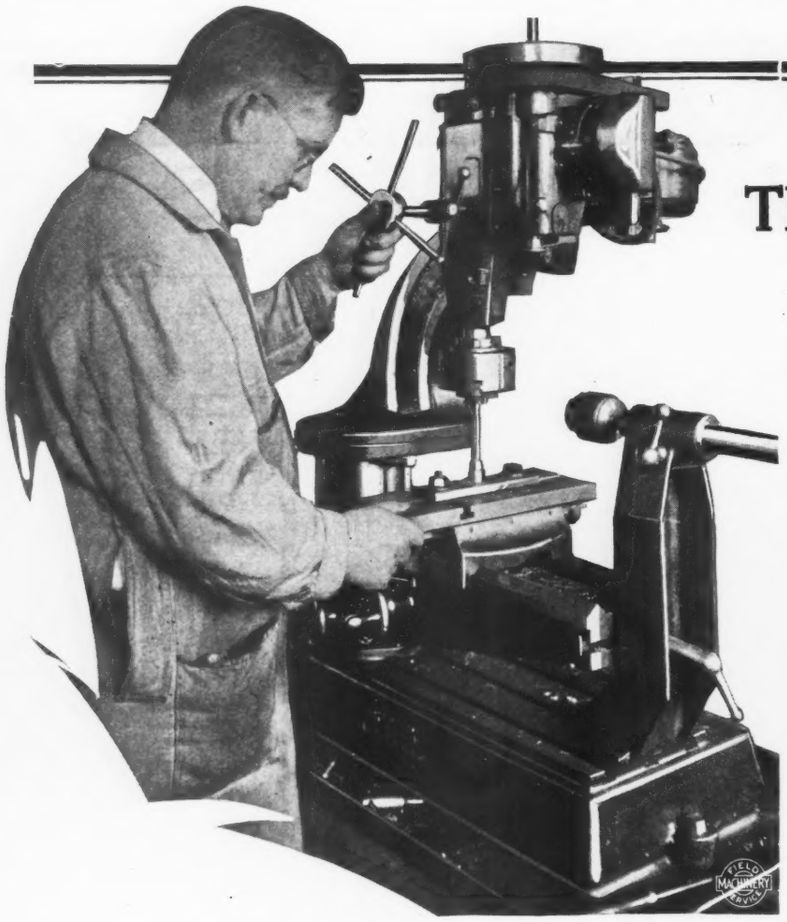
Name of Tool	Grades of Steel
Arbors	Red Star
Augers, Wood & Bits	Red Star
Axe	Red Star
Ball Bearings	Superior
Bits, Channeling Machine	Red Star
Bits, Coal Mining	Anchor
Bits, Tong	Red Star
Bits, Well Stone Drilling	Standard Well Bit
Bush Hammer, Stone Tools	Red Star Sheets
Bunter, Heading	Red Star
Broaches, Machine	No. 7, High Speed
Bushings	Red Star
Center Punches	Red Star
Center, Lathe (see L.)	Red Star
Chasers, Threading	H. S., No. 7, No. 14
Chain, Pipe, Links	Vanadium, Type A
Chisels, Pneumatic	No. 7
Chisels, Hand	Red Star
Chisels, Stone Cutters	Red Star
Chisels, Wood Working	Red Star
Cupping Tools	Red Star
Caulking Tools	Red Star
Claw Bars	Red Star
Creasers, Hot	H. S., No. 7 E
Counterbores	H. S., No. 14
Counterbores, Solid, Interchangeable	H. S., No. 7, No. 14
Collets, Bit Brace	Red Star
Collets, Spring	Red Star
Cutters, Fine Finishing	No. 5
Cutter, Pipe	H. S., No. 14
Cutters, Flue	No. 7, High Speed
Cutters, Flue Hole	No. 7
Cutters, Nail	High Speed
Cutters, Corn Stalk	Alto Sheets
Cutters, File	High Speed
Cutters, Milling, Plain	High Speed
Cutters, Form	High Speed
Cutters, Inserted Blade	High Speed
Cutters, Profile	High Speed
Cutters, Metal Slitting	High Speed
Cutters, Screw Slotting	No. 5
Cutters, Wood Forming	High Speed, No. 5
Cutting off Tools	High Speed
Dies, Bolt Threading	H. S., No. 7, No. 14
Dies, Blanking	H. S., No. 7, No. 14
Dies, Forming & Bending	No. 7, No. 14
Dies, Sub-Press	No. 7, No. 14
Dies, Drawing	H. S., No. 7, No. 14
Dies, Cartridge Shell	High Speed, No. 7
Dies, Hammer Dies, Power	Red Star
Flat Jack Jewelers' Dies	High Speed No. 7
Dies, Drop Forging	Red Star, Alto
Dies, Nail	High Speed
Dies, for Paper	H. S., No. 14
Dies, Pipe Threading	H. S., No. 7, No. 14
Dies, Solid & Adjustable Threading	H. S., No. 7, No. 14
Dies, Glove	No. 7, No. 14
Dies, Rivet	No. 7, Red Star
Dies, Shoe Knife	Red Star
Dies, Spring Screw, Threading	H. S., No. 7, No. 14
Dies, Solid Bolt	No. 7, No. 14
Dies, Adjustable, Round	
Dies, Split Threading	H. S., No. 7, No. 14
Dies, Spoon, Silver	No. 14
Dies, Silversmith	No. 7
Dies, Domino Screw Cold Heading	No. 7, Red Star
Dies, Cold Heading	No. 7, Red Star
Dies, Hot Heading	H. S. or No. 35
Dies, Wire Drawing	No. 14
Dies, Plates	No. 7, No. 14
Digging Bars	Red Star
Drills for Boring	Red Star
Drills, Tool Steel	H. S., Superior
Drills for Stone	Red Star
Drills, Twist	High Speed
Drills, Flat	High Speed
Engraver Tools	No. 14
Furnace Bars	Anchor
Flatters, Blacksmiths	Red Star
Fullers, Blacksmiths	Red Star
Forming Tools for Metals	H. S., No. 5, No. 14
Flange Tire Forming Tools	High Speed
Gear Cutters	High Speed
Gauges	Oil Hardening No. 6
Grip Dies for Rivets, Hot	No. 35
Hatchets	Red Star
Hammers, Blacksmiths	Red Star
Hammers for Crushing Machines	Red Star
Hammers, Pneumatic	No. 7
Hammers, Nail Machines	No. 7
Hammers, Riveting Pneumatic	No. 7
Hobs, Gear	H. S., No. 7, No. 14
Header Dies, Cold	No. 7, Red Star
Header Dies, Hot	No. 35
Jaw Chuck	Anchor
Jaw Vise	Anchor
Keys for Drop Hammers	Red Star
Knives, Pocket	Red Star Sheets
Knives, Carver	Red Star Sheets
Knives, Butcher	Red Star Sheets
Knives, Cleavers	Red Star Sheets
Knives, Back Spring	Alto Sheets
Knives, Heel Forming Shoe	No. 14
Knives, Shoe Makers	Red Star Sheets
Knives, Shoe Sole	Red Star
Knives, Surgical	No. 14
Knives, Table	Alto Sheets
Knives, Potato	Alto Sheets
Knives, Corn Knife	Alto Sheets
Knives, Drawing	No. 14, Red Star
Knives, Hog	No. 14
Knives, Machine	H. S., Red Star
Knives, Paper	H. S., or No. 14
Knives, Shear	No. 7, Red Star
Knives, Wood Working	H. S., Red Star
Knurling Tools	No. 7, No. 14
Lathe Centers, Dead	Red Star
Lathe Center, Live	Red Star
Lathe Tools for Metal Turning	High Speed
Lathe Tools for Woodworking	High Speed
Liners for Brick Dies	Imperial
Letter Stamps, Hand	No. 7, No. 14
Letter Stamps, Roll	No. 7, No. 14
Mandrels	Red Star
Mills, End	High Speed
Mills, Hollow	High Speed
Mills, Shell End	High Speed
Piercers, Hot	High Speed
Pick Steel	Alto
Pinion Bars	Red Star
Pins, Drift	Red Star
Pinch Bars	Red Star
Planer for Metal Tools	High Speed
Planer for Stone	High Speed
Planer for Wood	Red Star
Point Steel for Stone Cutters	Red Star
Punches, Cartridge Shell	No. 7
Punches, Hand—Hot or Cold Work	H. S., or No. 7
Punches, Drawing	No. 7, No. 14
Plug Gauges	No. 6, Oil Hard'ng
Pneumatic Tools	No. 7E or F
Reins, Tong	Red Star
Rods, Piston	Red Star
Reamers, Hand, Solid	H. S., or No. 5
Reamers, Shell	High Speed
Reamers, Taper	High Speed
Reamers, Rose, Chucking	High Speed
Reamers, Locomotive, Taper	No. 14, H. S.
Reamers, Bridge	High Speed
Reamers, Expansion, Hand	High Speed
Reamers, Drill & Center	No. 5
Rolls, Flue Expanding	No. 7
Ring Gauges	No. 6, Oil Hard'ng
Rivet Sets	No. 7, Red Star
Shear Blades—Hot Work	H. S., No. 7
Shear Blades—Cold Work	No. 7, Red Star
Saws, Circular Metal	H. S., Nikro
Saws, Circular Wood	Nikro
Scrapers for Scraping Machine Parts	No. 5
Scrapers, Tube	Red Star
Screw Drivers	Red Star
Set—Rivet	No. 7, Red Star
Sets—Button	No. 7, Red Star
Sets—Nail	Red Star
Splining Tool	High Speed
Shaper Tool	High Speed
Stamping Tools	No. 7, No. 14
Sledges, Blacksmith & Stone	Red Star
Snaps, Rivet	No. 7, Red Star
Springs	Red Star
Swages, Blacksmith	Red Star
Swaging Metal	No. 7
Taps, Tapper	No. 14, Red Star
Taps, Hand	Red Star Tap, Extra No. 14
Taps, Machine	H. S., Red Star
Taps, Automatic Machine Screw	High Speed, No. 7
Taps, Straybolt	No. 14
Taps, Pipe Taps	Red Star
Taps, Pipe Tap Chasers	High Speed, No. 3
Tire Turning	High Speed
Tool Holder Bits	High Speed
Wedge, Stone	Red Star
Wedges	Red Star
Wrenches, Track	Red Star

Full instructions for hardening and tempering all Colonial Tool Steels will be found in the *Colonial Heat Treating Book*. MAILED FREE.

Visit us at the Steel Treaters' Convention, Space 43.

Colonial Steel Company

PITTSBURGH BOSTON NEW HAVEN NEW YORK PHILADELPHIA CLEVELAND CINCINNATI DETROIT CHICAGO ST. LOUIS



B.C. AMES CO.
WALTHAM MASS. U.S.A.

Three Machine Tools in One

The Triplex Machine does the work of three separate and distinct machines—Milling Machine, Drilling Machine and Lathe—it is *three* machine tools in one—a single self-contained unit that can be bought for much less than the three machines which it replaces. The universal feature of the Triplex saves time in making job set-ups and in many cases eliminates the necessity of changing the position of the work when performing a variety of operations—cost and time are thereby greatly reduced.

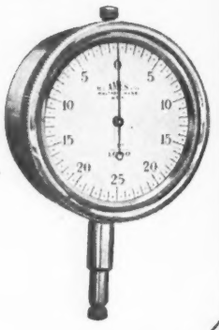
The Triplex is an ideal machine for shops of limited floor space, it requires but one quarter of the space which would otherwise be required by machines to do its work.

Send for catalog for details of this and other Ames Machines.

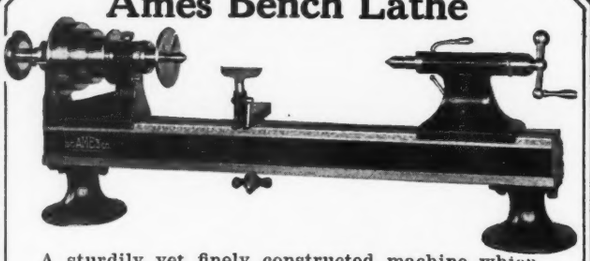
Ames Dial Gauges

Ames Dial Gauges are so ruggedly constructed that they can be handled by inexperienced men without detriment to their accuracy. Ames Dial Gauges, like all Ames Precision Tools have distinctive advantages which make them more than ordinarily profitable.

Let us tell you more about them.



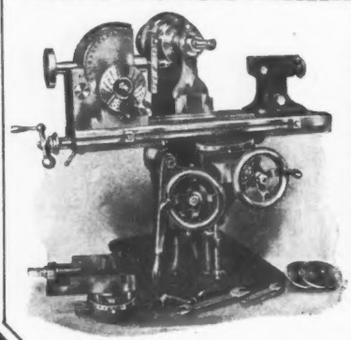
Ames Bench Lathe



A sturdily yet finely constructed machine which can be used for manufacturing all manner of small precision tools and for delicate experimental work.

A variety of interchangeable attachments make it practically universal for work within its range.

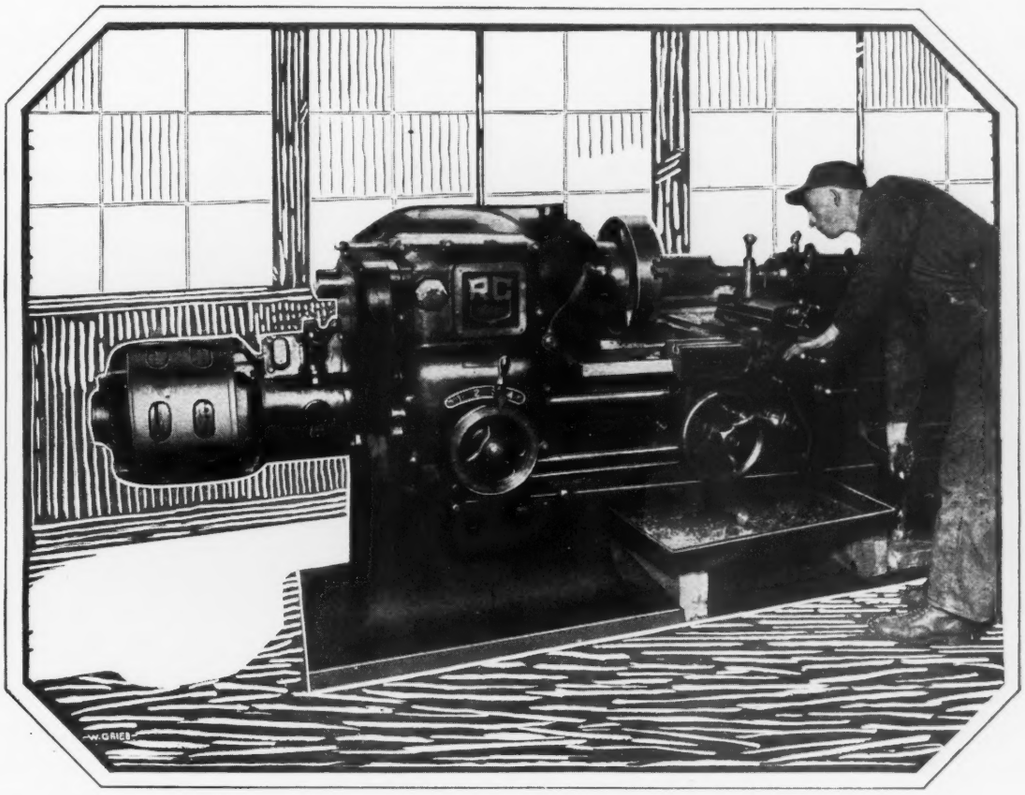
Ames Bench Milling Machines



A handy little toolroom miller for accurate light milling in tool, jig and model work, as well as general manufacturing. Can handle medium heavy work and yet is extremely sensitive and well adapted to precision operations.

Ames Bench Drill

For drilling very small holes, as in the manufacture of watches, clocks and instruments. Capacity ⅛" in brass and 1/16" in steel. Heads may be used singly or in gangs. Speeds up to 10,000 R.P.M. Best speeds in brass 5,000 to 10,000.



Ryerson-Conradson Lathes Are Doing the Heavy Jobs

Ryerson-Conradson Lathes are doing the heavy jobs in Heavy Manufacturies, Steel Mills, Railway Repair Shops and other places where the going is too heavy for the ordinary lathe.

Various exclusive features enable it to give that dependable service so necessary to the peace of mind of the official responsible for upkeep and maintenance.

Special Bulletin 1,301 gives full details.

JOSEPH T RYERSON & SON INC.

Established 1842

Plants: CHICAGO ST. LOUIS CINCINNATI DETROIT BUFFALO NEW YORK

Branch Offices: Minneapolis Milwaukee Denver Tulsa Houston San Francisco

RYERSON MACHINERY

Better Grinding in Less Time on

The Heim Centerless Grinder

This manufacturer of automobile parts and accessories takes his cue from the big car builders and handles every operation with the efficiency that makes production profitable. Finishing fan shafts 5⅞" long, .6105" in diameter to specified limits at the rate of eight per minute is only one of the operations made profitable by the Heim Centerless Grinder.

Heavy, powerful—its rigidity makes it the ideal machine for maximum production, not only on rough grinding but on work requiring the closest limits of accuracy.

Heim capacity is not limited to straight cylindrical grinding. It is equally profitable on taper grinding, grinding to shoulders, and other unusual applications.

Let us tell you about this machine.

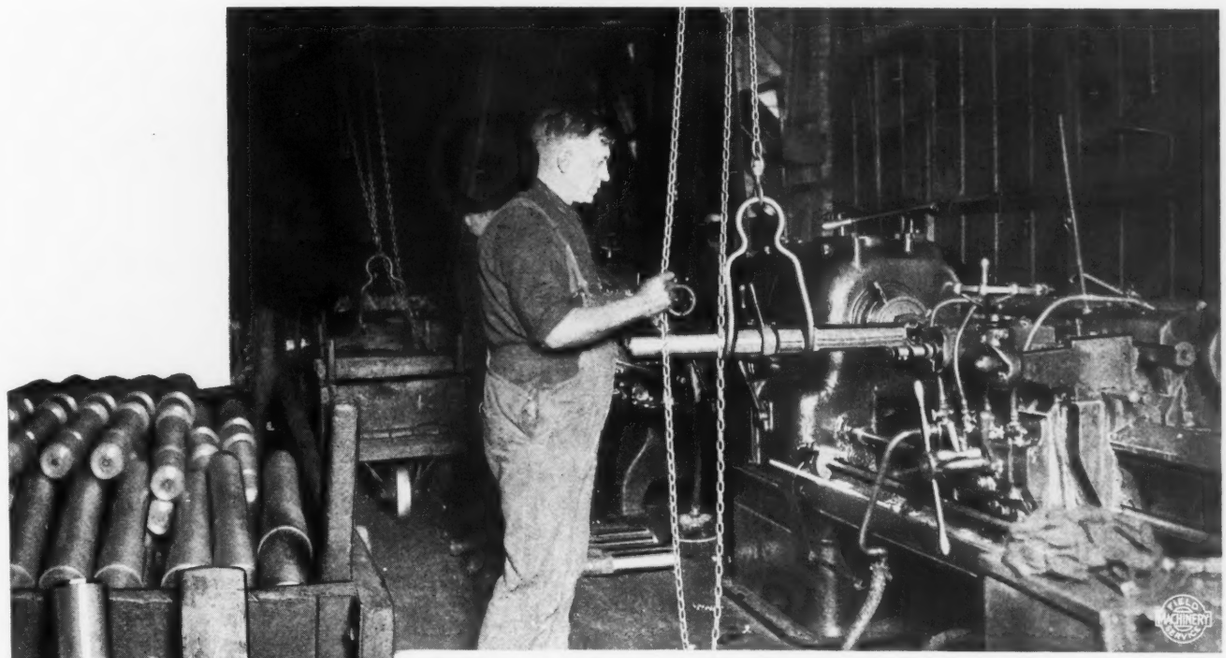
The Heim Grinder Company
Danbury, Conn., U.S.A.

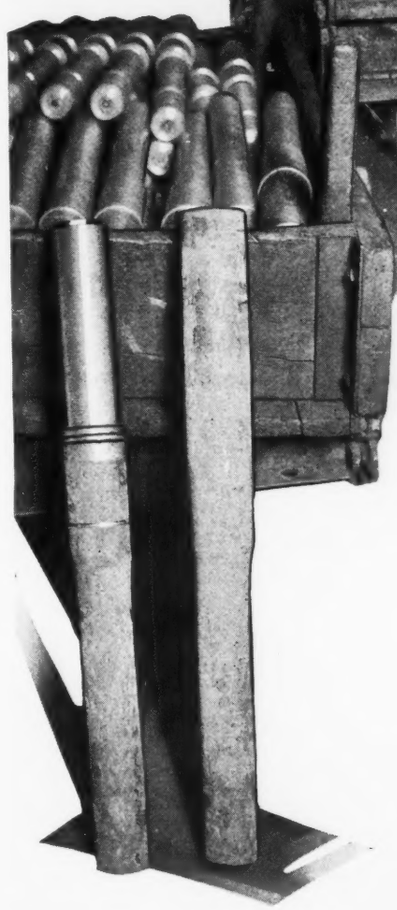
NOTICE

This company has acquired the ownership of the centerless grinder patents issued and pending, formerly the property of Lewis R. Heim and The Ball & Roller Bearing Co., and is the successor to the centerless grinding business of the latter company. The patents include Reissue Patent No. 15035 recently sustained by the decision of the U.S. Circuit Court of Appeals, Second Circuit.

This Company is also the owner of all the centerless grinder patents of the Reeves Pulley Co.

We will fully enforce our rights under these patents.





From Cam Shafts to Axles on *Lo-swing* Lathes

Labor saving agricultural equipment has been placed within reach of the farmer's purse by the efficient use of such machines as *Lo-swing* Lathes in the manufacturing processes. There are shafts of all kinds in the tractors, trucks, mowing machines, etc., produced in the plant where these photographs were taken—**and from cam shafts to axles they are all turned on eight *Lo-swing* Lathes.**

The operation shown is the first step in turning rear axle shafts for a tractor. One end is turned to a diameter of 2.999″ for about 10 3/16″, and to a diameter of 3″ for about 2″; two grooves are cut and the end is faced—all this *simultaneously* in the time it takes to complete the longest operation. For greater speed the remaining diameters are turned on a second *Lo-swing* Lathe.

If you want to cut costs on this class of work ask for details of method and results.

The *Lo-swing* production method, of combining a series of operations into a single one under the direction of a single operator not only insures uniform accuracy and better production, but decreases equipment, power, upkeep and labor costs.

Fitchburg Machine Works, Fitchburg, Mass.

REPRESENTATIVES: Detroit and Cleveland District, W. H. Nettlé, 236 Richton Ave., Highland Park, Detroit, Mich. Chicago, Milwaukee and St. Louis District, W. A. McCarrell, 429 Kenwood Boulevard, Milwaukee, Wis. New York State District, W. H. Dana, 137 E. Brighton Ave., Syracuse, N. Y.

France, Italy and Belgium, G. E. Fogarty, 42 Rue le Peletier, Paris 9e, France. Norway, Sweden and Denmark—Aktiebolaget Servus, Kungsgatan, 28, Stockholm, Sweden. British Isles—Buck & Hickman, Ltd., 2 and 4 Whitechapel Road, London, E1, England.

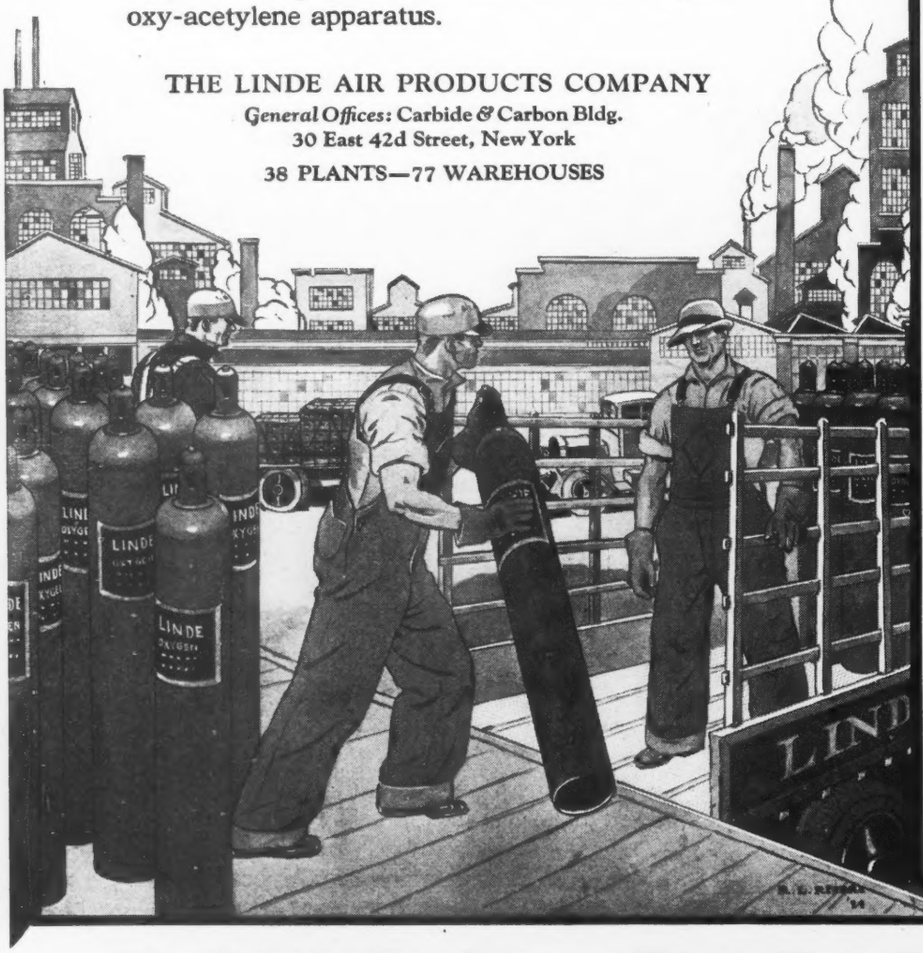
Service means many things

SERVICE means many things; with oxygen, it includes delivery. And good delivery means not occasional or irregular service, but day after day, dependable service.

Dependable delivery is not just a matter of ability to deliver, for facilities would be of little use to you were they not backed by a will to serve. Linde's ability to deliver is found in 115 plants and warehouses; Linde's will to serve is proved by an enviable record.

Service means many other things. One is "Oxy-Acetylene Tips" which will be sent free each month to help you make the best use of your oxy-acetylene apparatus.

THE LINDE AIR PRODUCTS COMPANY
General Offices: Carbide & Carbon Bldg.
30 East 42d Street, New York
38 PLANTS—77 WAREHOUSES



"Based on Practical Experience"

These are the words used by *Industrial Gases* in reviewing one of the books published by the Linde Company.

Linde books are "based on practical experience"—practical experience gained through Linde's service to its customers, which brings Linde in daily contact with the needs of these customers.

"The Oxygen Lance in Blast Furnace and Steel Plants" is one of these books, now in its second edition

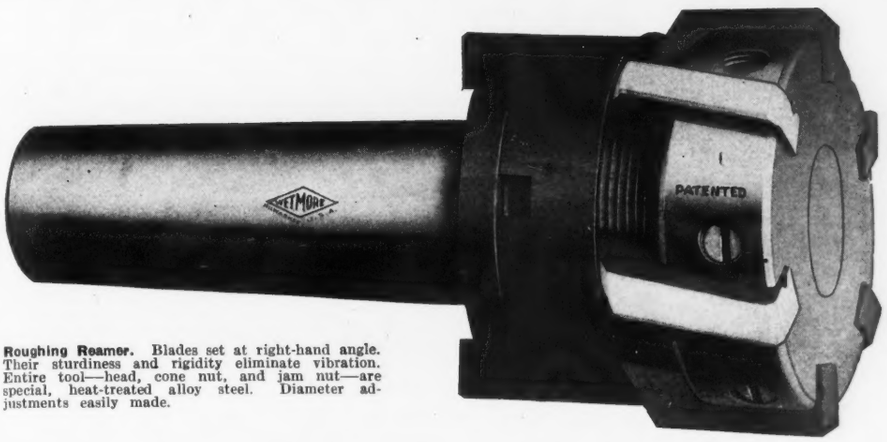
Acetylene Journal says: "This book describes the equipment used for burning out frozen tap holes in blast furnaces. It also describes blast furnace construction, the opening of iron and slag notches, and the reopening of frozen tuyeres, the drilling of salamanders, and the breaking up of spills, ladle skulls, etc. These operations can all be accomplished to great advantage with the Oxygen Lance."

This is only one of the books on various phases of the oxy-acetylene process, issued by Linde as a part of Linde Service. All of them are "based on practical experience." They are free to Linde users. Ask the nearest Linde District Sales Office about them.

LINDE OXYGEN

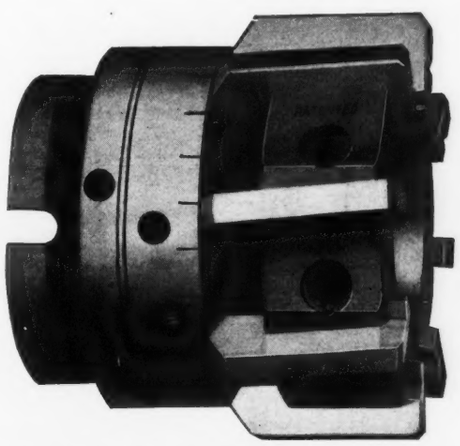
YOU CAN DEPEND ON THE LINDE COMPANY

THE BIG THREE



Roughing Reamer. Blades set at right-hand angle. Their sturdiness and rigidity eliminate vibration. Entire tool—head, cone nut, and jam nut—are special, heat-treated alloy steel. Diameter adjustments easily made.

—why Wetmore Cylinder Reaming Sets Speed Up Production

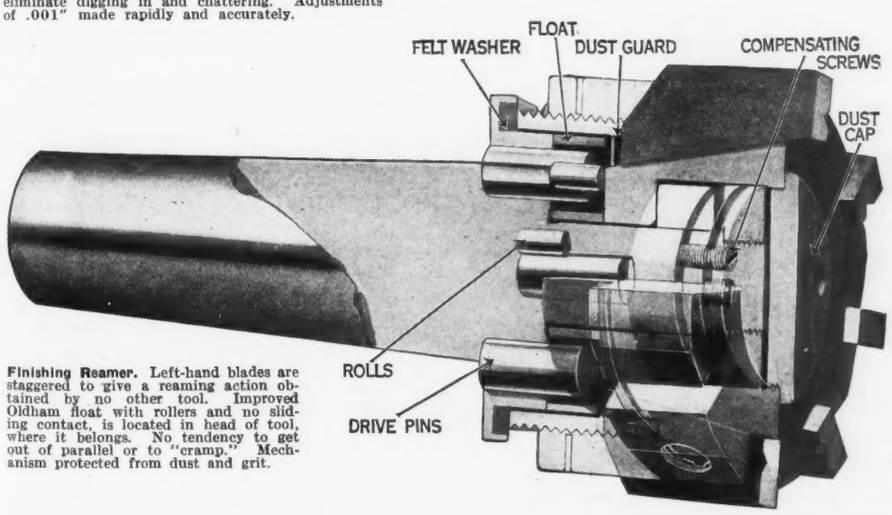


Semi-Finishing Reamer. Left-hand angle blades eliminate digging in and chattering. Adjustments of .001" made rapidly and accurately.

Unusual *durability* and *sturdiness*, plus *greater working speed* and *less vibration*—that's the combination you get in the three expanding reamers of Wetmore Cylinder Reaming Sets!

Note the extreme ruggedness of the Roughing Reamer (top). The Semi-Finishing Reamer (middle), with its left-hand angle blades, eliminates digging in and chattering. It assures a straight, round hole with no scoring. The construction of the Finishing Reamer (bottom) assures a smooth, glass-like finish to the cylinder wall.

Wetmore Cylinder Reamers are standard in many of the largest motor manufacturing plants. A trial in your shop, in competition with other reamers, will prove that they save time and money.



Finishing Reamer. Left-hand blades are staggered to give a reaming action obtained by no other tool. Improved Oldham float with rollers and no sliding contact, is located in head of tool, where it belongs. No tendency to get out of parallel or to "cramp." Mechanism protected from dust and grit.

Wetmore Reamer Company
MILWAUKEE, WISCONSIN

Get this Free Catalog!

Write on your business letter-head for the Wetmore Reamer Catalog, showing complete line of cylinder reaming sets, standard, heavy-duty, shell and small machine reamers. Also arbors and replacement blades. Sent *free, postpaid*—no obligation to you.

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

Red Cut Superior high speed steel

Typical Red Cut Superior Performance

In the plant of the Liberty Machine Tool Company, Hamilton, O., Mr. Schneider, lathe foreman, tells us a Red Cut Superior Tool 5/8" x 1¼" turned 78 steel shafts, each shaft being 3½ feet x 2¾ inches in diameter—removing 1/8 inch metal with 3/64 feed and running 80 feet per minute *without taking the tool out of the tool post.*

Let our representative show you how "Red Cut Superior" Tools can give equally satisfactory performance in your plant.

VANADIUM ALLOYS STEEL COMPANY

LATROBE, PENNA.

WAREHOUSES:

Latrobe Chicago Detroit Springfield Los Angeles San Francisco St. Louis

BRANCH OFFICES:

New York Philadelphia Buffalo Boston Cincinnati
Pittsburgh Cleveland Dayton Dallas

Forging in Automobile Production

These three illustrations show Ajax Machines in the plant of a leading automobile manufacturer.

No industry demands greater *economy* in production and higher *quality* in product than does the automotive industry. And yet Ajax Machines and their products measure up to both.

Bulletin 47-A describes the Upsetting Forging Machine in Figure 1; Bulletin 28-A the Hot Saw and Burring Machine in Figure 2; and Bulletin 42-A the Forging Rolls in Figure 3. These Bulletins we will be glad to supply you upon request.

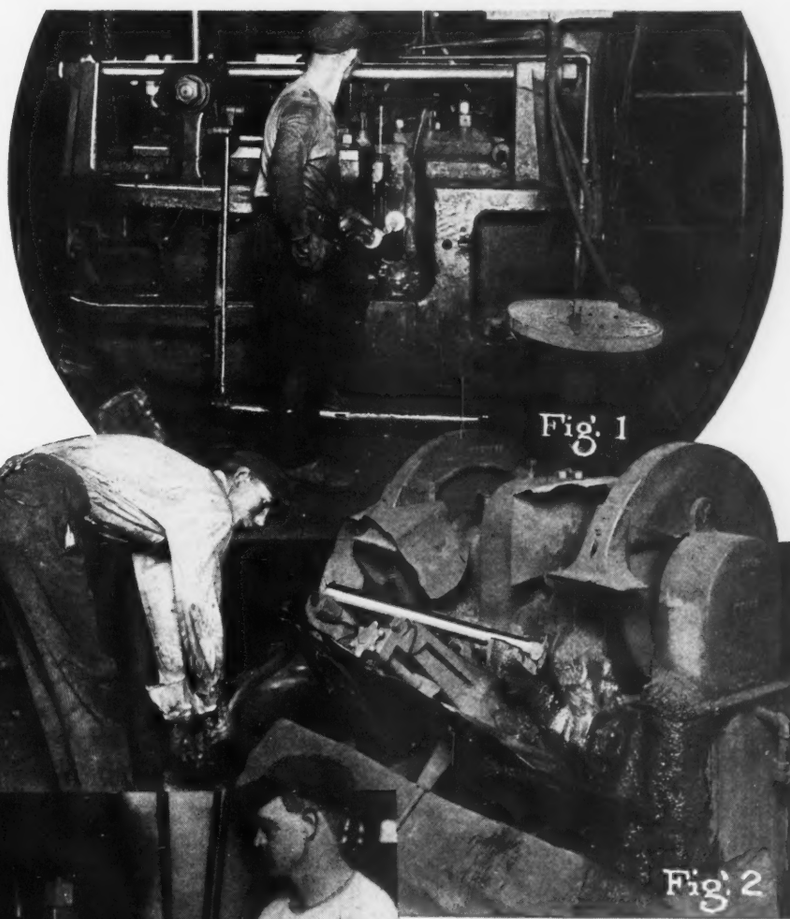


Fig. 1

Fig. 2

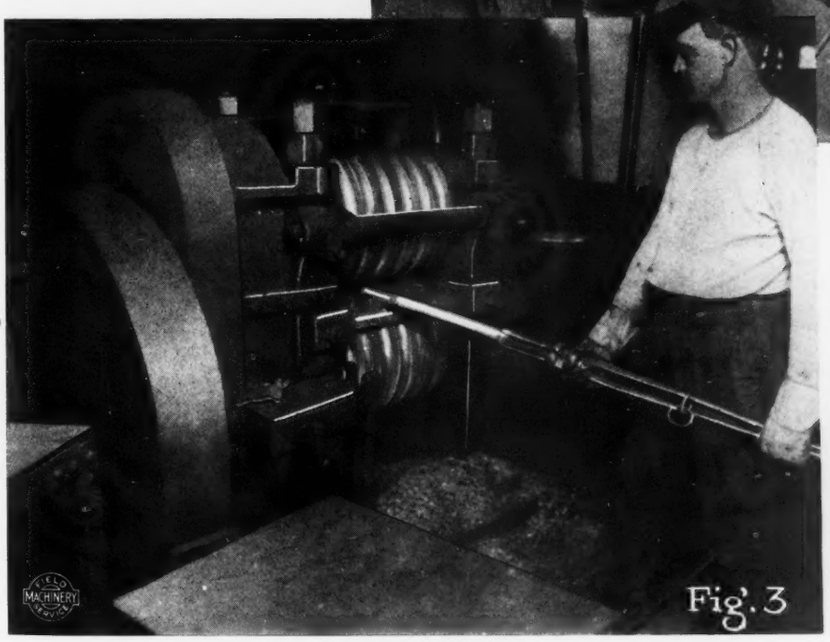


Fig. 3

The Ajax Manufacturing Company

Cleveland, Ohio

621 Marquette Building
CHICAGO, ILL.

1369 Hudson Terminal
NEW YORK CITY

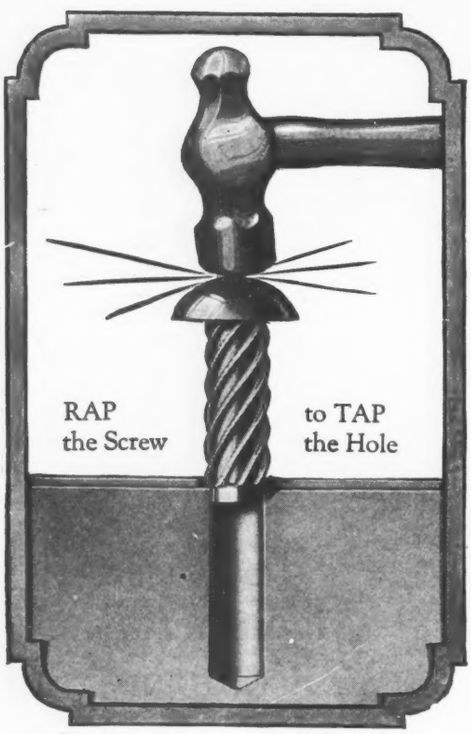
AJAX

(Trade Mark Registered)

O.K'd by 2,500 leading manufacturers!

for Attaching Name Plates and Making Other Permanent Fastenings

to Steel, Cast Iron, Brass, Aluminum, Bakelite, etc.



The illustration shows a Hardened Metallic Drive Screw being driven into a steel casting.

More than 2500 manufacturers of mechanical and other devices made of steel, cast iron, etc., are using Hardened Metallic Drive Screws in place of machine screws, escutcheon pins, etc., for attaching name plates and making other permanent assemblies.

For 3 good reasons:

(1) They eliminate the costly tapping operation involved in the use of machine screws—effecting savings in time and labor as high as 75%.

(2) They hold better than machine screws or escutcheon pins—vibration can't loosen them.

(3) They're easier to use—simply drill a hole and hammer the Screw in.

When such concerns as the General Electric Co., the Westinghouse Electric & Mfg. Co., the Black & Decker Mfg. Co., the Ford Motor Co., the Hoover Company and hundreds of others as prominent can use Hardened Metallic Drive Screws profitably, the chances are you can, too.

Investigate their possibilities for saving time and labor in your plant. Send for samples and full information.

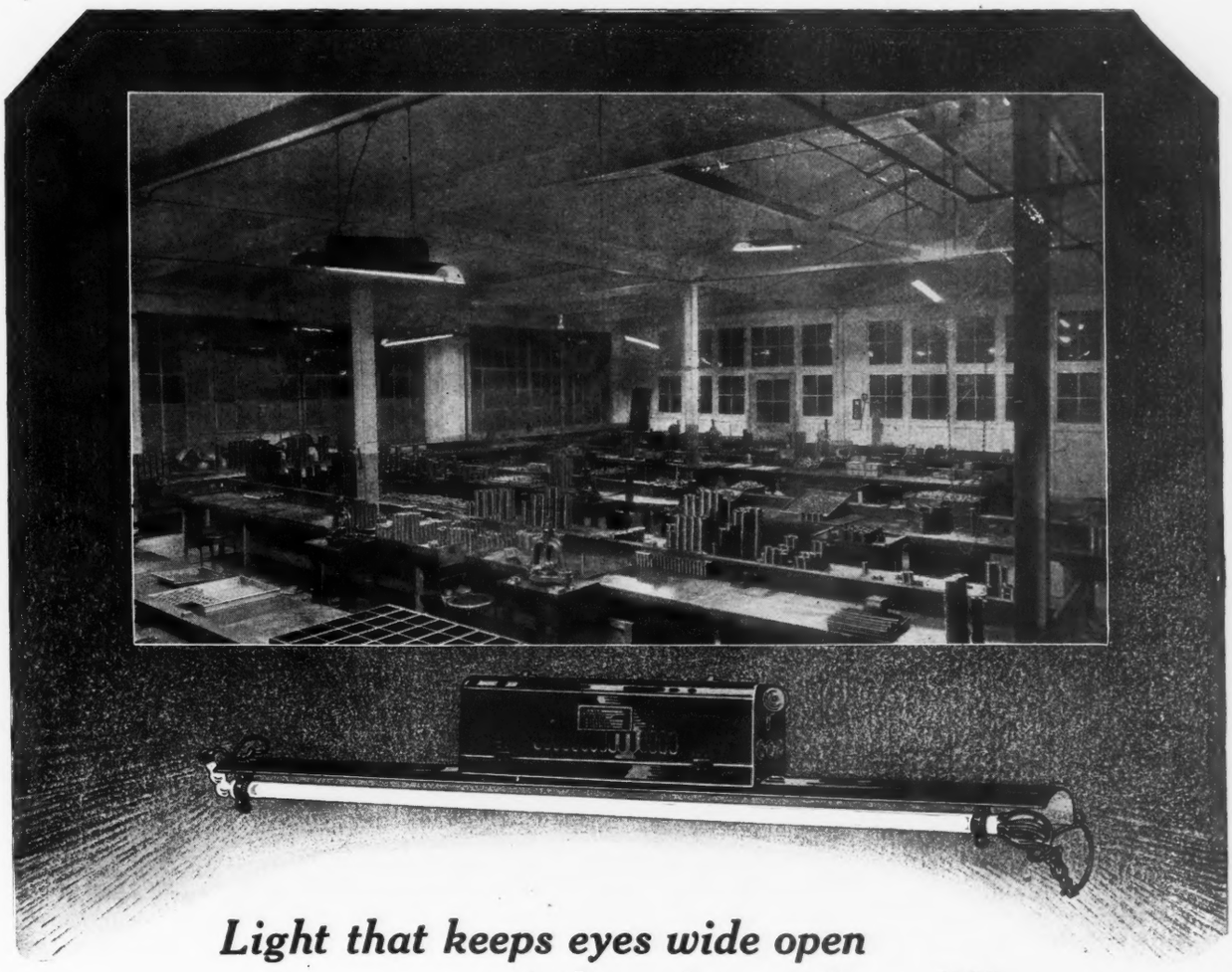
PARKER-KALON CORPORATION
353 West 13th St., New York, N. Y.
Distributors in Principal Cities

Agents for British Isles:
Charles Churchill & Co., Ltd., Finsbury, London E.C., 2, England

Parker-Kalon
Hardened Metallic
Drive Screws

(Pat. Jan. 29, 1924)

Driven Like a Nail—Holds Like a Screw



No operation makes greater exactions upon light than the inspection of bearings. The above night view of the inspection room of the Bearings Co. of America plant at Lancaster shows how vividly detail is brought out under Work-Light.

Light that keeps eyes wide open is bound to make a difference

ALL the wonder, all the surmise, all the questions that have been caused by the performance of Cooper Hewitt Work-Light in hundreds of American manufacturing plants can be answered in one simple sentence:

"It is light that keeps eyes wide open."

That explains more and better production. It explains reduced accident hazard—reduced labor turnover—and points out, as well, a real basis for economical plant operation.

Let a manufacturer*—one of the most famous names in industry—bear us out. He writes:

"The light is easier on the eyes.
"The men are able to work with less fatigue.
"The length of the tube eliminates shadows.
"The low intensity in the tube eliminates glare."

Multiply that advantage in *seeing power* by the number of men and machines in a plant, and the "reason why" of Work-Light is made clear.

Eyes stay wide open under Work-Light because it is nine-tenths composed of greenish-yellow rays, the seeing rays of light. Thus the eyes have to focus practically for one color only, instead of the six that *blur the image and create fatigue in all other light.*

The Work-Light tube diffuses light evenly from a source fifty inches long, practically eliminating shadows and removing all possibility of glare.

The worth of any lighting system can fairly be judged only by the amount of perfect work produced by its aid. Put the question to a plant that you know is using Work-Light—or send for the Work-Light booklet today. Cooper Hewitt Electric Co., Hoboken, N. J.

103 River Street

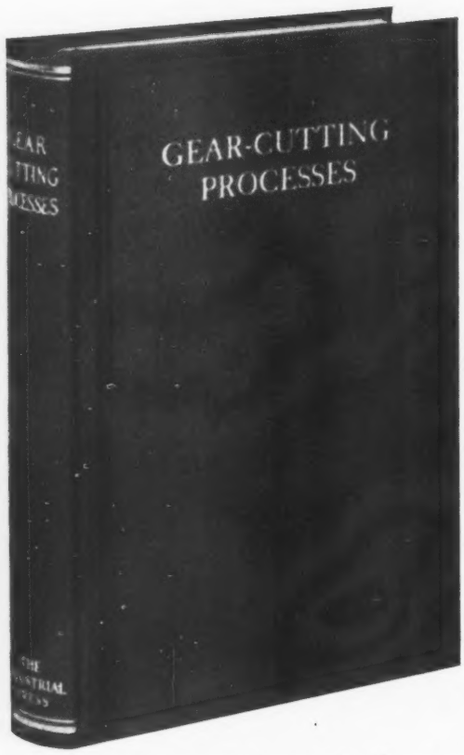
* *Name and complete letter upon request.*

COOPER HEWITT

Work-Light

26 © C. H. E. Co. 1924

A NEW MACHINERY BOOK



Gear-Cutting Processes

This new book does more than merely explain how machines are adjusted and used in the cutting of different classes of gears, it gives a clear exposition of the relation existing between the principles of gearing and the cutting processes. Further, it treats of the effect of gear accuracy and quality upon the selection and use of various gear-cutting methods. The treatment of the subject from beginning to end is pre-eminently practical.

"Gear-Cutting Processes" presents its subject in such a way that readers will understand all about the methods of cutting gears as well as the reasons why various processes and types of machines are used in order to meet commercial requirements in different branches of the machine-building industry.

The cutting of all ordinary types of gearing is dealt with including spur gears, straight tooth bevel gears, spiral bevel gears, helical and herringbone gears, internal gears, racks, worm gears and worms.

There are numerous examples from practice, with commercial rates of production, for gears cut by different processes. Recent developments in gear-tooth grinding are included and specific information covering operating principles and the methods of setting up or adjusting machines of different types. The use of standard milling machines for gear-cutting has been explained, as such machines are often employed where types designed primarily for gear-cutting are not available.

The following list of Chapter Heads indicates the scope of this book, its thoroughness and its value to all who have anything to do with the cutting of gears:

General Principles of Gearing and Classification of Cutting Processes
Use of Standard Milling Machines for Gear-Cutting
Cutting Spur Gears on Automatic Gear-Cutting Machines
Cutting Spur Gears on Gear Shapers and Gear Planers
Hobbing Process as Applied to Spur Gears
Cutting Internal Spur Gears
Formed-Cutter and Generating Methods of Cutting Bevel Gears
Cutting Worm-Gears and Worm Threads
Cutting Large Bevel Gears on Planers of Templet Type
Machines of Generating Type for Cutting Spiral Bevel Gears
Special Machines for Roughing Bevel Gears and Pinions
Cutting Helical Gears on Hobbing Machines and Gear Shapers
Cutting Double-Helical Gears on Hobbing Machines and Planers
Rack-Cutting
Small Gears for Instrument Work
Finishing Gear Teeth by Grinding

"Gear-Cutting Processes" is a MACHINERY Library Book, bound in dark green cloth—size 6 x 9—342 pages, generously illustrated with pictures of actual shop operations—Price $3.00. Sent on approval—just fill in the form below.

FREE EXAMINATION FORM

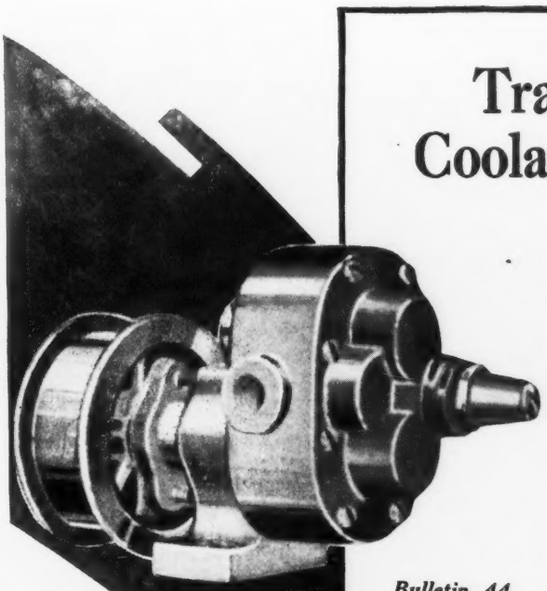
THE INDUSTRIAL PRESS, Publishers of MACHINERY,
140-148 Lafayette St., New York City, N. Y.

You may send me "Gear-Cutting Processes" on approval. I will examine it and if satisfied send you $3.00 within 10 days; otherwise the book will be returned within five days.

Name .....
Address .....
City and State.....*Position* .....
Firm .....

8-24

Trahern Pumps Force the Coolant into the Deepest Cuts

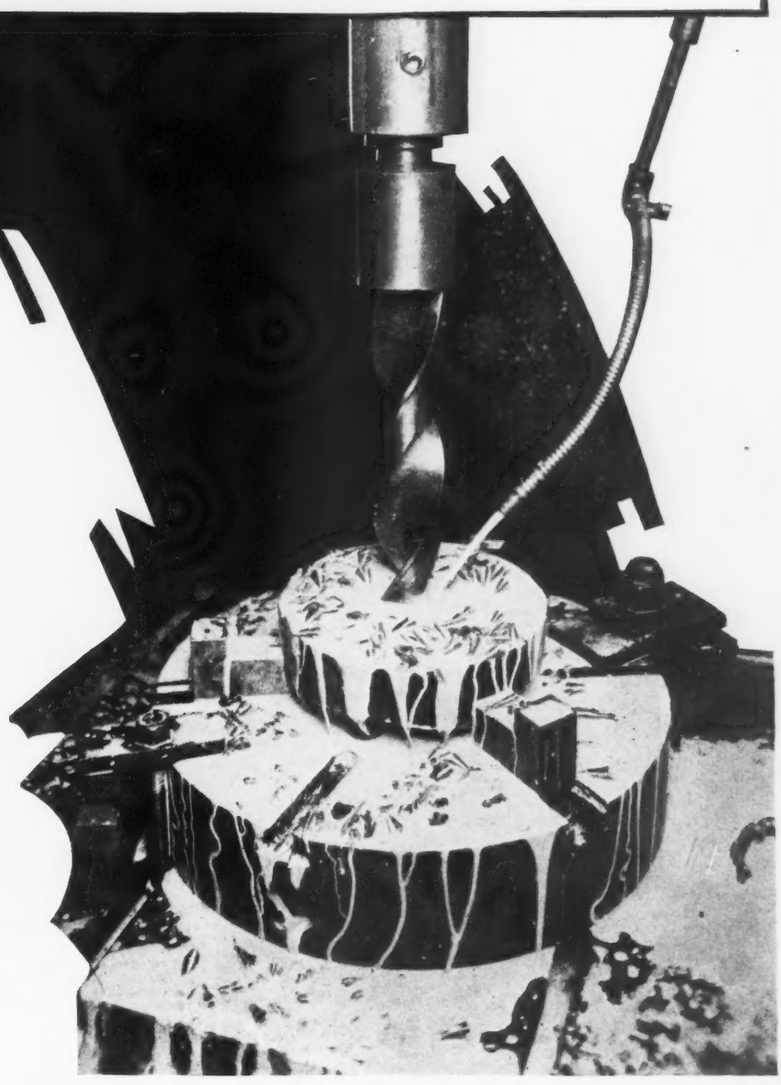


This drill is being forced, with heavy feed and at high speed. If the flow of coolant stops for an instant, you know what happens to the drill. That's why a Trahern Pump is the force behind that indispensable stream of coolant.

Trahern Pumps dependably meet every pumping need, from 1 drop to 26 gallons of coolant per minute; against high or low pressure; without pulsation; with force enough to reach the deepest cuts and bores.

Bulletin 44 describes the many advantages of Trahern Pumps. Send for it.

When properly installed, Trahern Pumps keep primed,—keep pumping and keep *popular* with mechanical men who expect unrelaxing service from the coolant pump that protects their high speed tools.



REG. TRADE MARK
TRAHERN
REG. U. S. PAT. OFF.

LEADER-TRAHERN COMPANY

DECATUR ILLINOIS

New York City: 21 East 40th St.
Chicago: 327 S. LaSalle St.

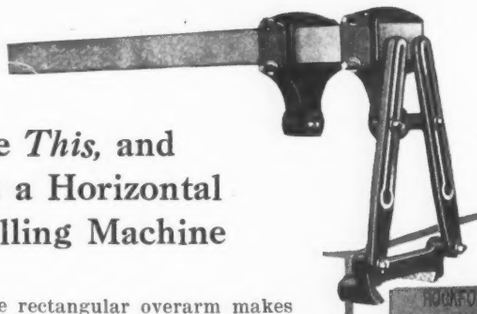
Plants: DECATUR and ROCKFORD, ILL.

DRILLING AND MILLING MACHINES

ROCK

Sund st

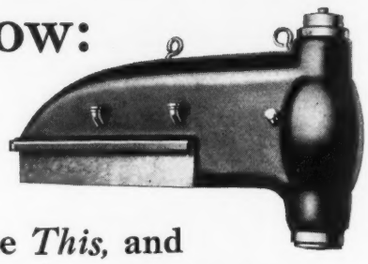
Two Machines in One! Here's How:



Use *This,* and it's a Horizontal Milling Machine

The rectangular overarm makes the Rockford No. 3 Heavy Duty Miller a machine with many advantages. The overarm, after loosening the two eccentrics and the bolt holding the triangular brace to the knee, can be moved out by a rack and pinion, eliminating the trouble of taking out brackets and arbor supports in order to change cutters or remove work. Since it is in alignment with the main spindle, the overarm may be used as a base for gaging in order to set up the work parallel to the spindle.

If you want production, want to cut costs, write us, and we will send a representative to tell the whole story.

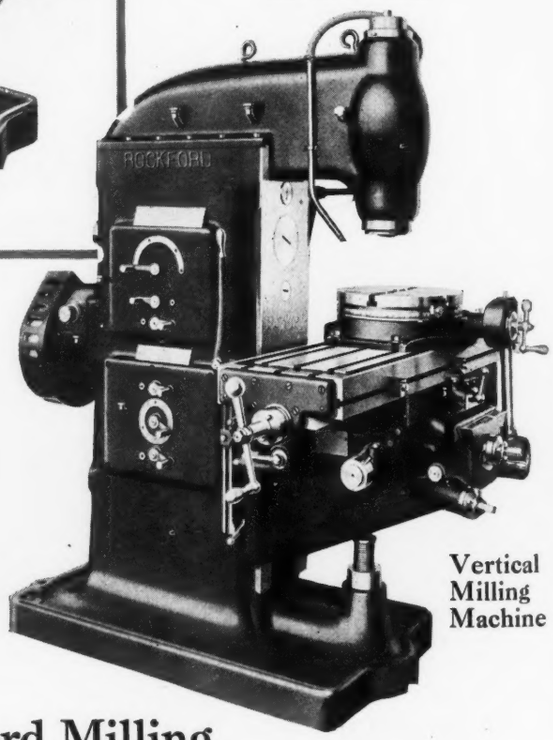


Use *This,* and it's a Vertical Milling Machine

When the job calls for a Vertical Miller, remove the rectangular overarm and put in its place the Stationary Vertical Head, perhaps the most outstanding of the attachments designed for this machine. The vertical spindle is driven through gearing by a large bull gear inside the column, giving the same spindle speeds as available on the horizontal spindle. Another interesting fact is that two throat distances may be had—15" or 20⅜" —retaining all spindle speeds.

Send for the details

Ready for Either Overarm or Vertical Milling Attachment



Vertical Milling Machine

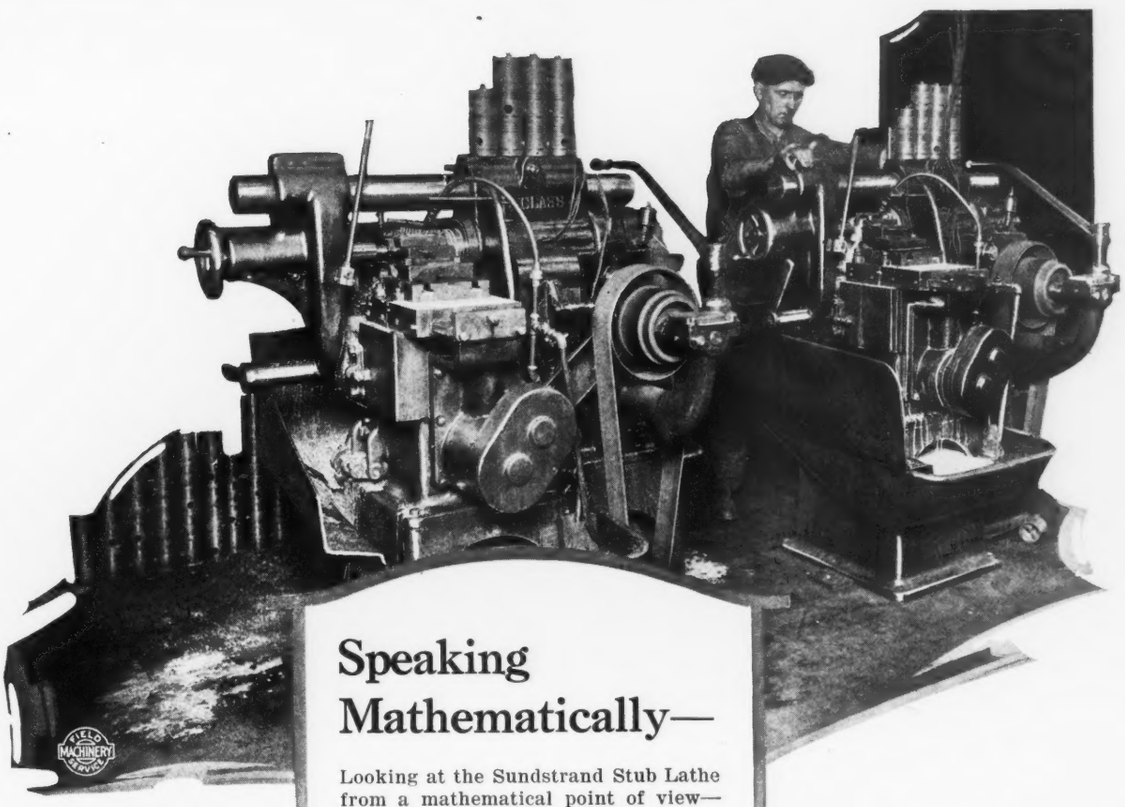
Horizontal Milling Machine

Rockford Milling Machine Co., Rockford, Ill.

FOREIGN AGENTS:—Louis Besse, 39 Rue de Lappe, Paris, France; Casamitjana Hermanos, Apartado 503, Barcelona, Spain; A. A. Jones & Shipman, Ltd., New Century Works, Leicester, England; Roku-Roku-Shoten, 3 Shinsakana-cho, Kyobashi-ku, Tokyo, Japan; Selson Engr. Co. (for Australia), 24 Stone St., New York City, N. Y.; Aktiebolaget Servus, Kungsgaten 28, Stockholm, Sweden; Wynmalen & Hausman, Rotterdam, Holland; Manning, Maxwell & Moore, Inc. (for Brazil and Columbia, S. A.), Pershing Square Bldg., New York City, N. Y.; R. S. Stokvis & Fils, 1-A Boulevard Du Jardin Botanique, Brussels, Belgium; Marx & Traube, Mainzedlandstrasse Nr. 51, Frankfurt, Germany.

d strand ORD

LATHES, SPECIAL MACHINERY



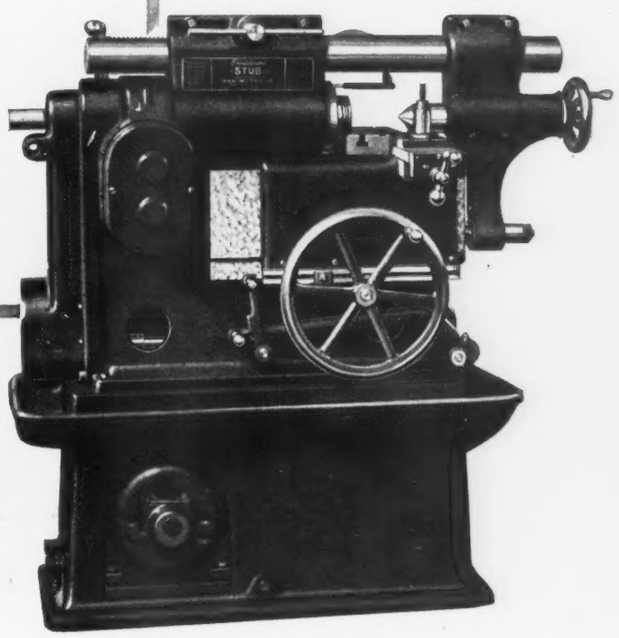
A Duo of Sundstrand Stubs turning Pistons in the Plant of a large Automobile Manufacturer.

Speaking Mathematically—

Looking at the Sundstrand Stub Lathe from a mathematical point of view—

Why not *add* it to your shop equipment? It will *subtract* from worries and costs in the wide field of work it covers. It will *multiply* output. It will enable its owners to *divide* greater profits.

And if you want to get even more *squarely* to the *root* of the value of Sundstrand Stub Lathes, send us your blueprints or samples. We'll give you figures that prove it.



Sundstrand Stub Lathes are applicable to an unlimited number of production jobs. Particularly in turning automobile wheel hubs, automobile steering knuckles, pulleys, bushings, ball joints and hundreds of similar jobs, the Stub is a prodigy of production.

Sundstrand Stubs are so fully automatic that an operator can easily handle two machines and, if the operations are carefully staggered, on many jobs three Stubs require only one man.

From 60 to 90% of your turning probably can be done best on a short bed lathe. Install one in your plant—and be sure it's a Sundstrand!

Rockford Tool Company, Rockford, Illinois

Agents in Principal Cities

Harder Tools—Truer Dies—with Hump Method Equipment

Six years ago the Cutter Company, Philadelphia, maker of electric circuit breakers, adopted the Hump Method for heat-treating the many dies and tools used in the manufacture of this apparatus. There is no question in the minds of these people about the advantages of Hump Method electric furnaces and equipment. The dies are truer after hardening than they used to be; there's far less distortion in the intricate shapes; they have a decidedly harder surface; they require much less grinding, lapping and trueing up. Their tools, because they are harder, have appreciably greater life. These are the net results obtained by the Cutter Company's installation. In addition, the Hump Method is clean, safe, sure, trouble free—and the entire installation takes up very little room.

If you want to corroborate any of these statements write the Cutter Company; if you want specific facts concerning your own particular work write us.

We've just printed a new booklet on heat-treating methods—perhaps you'd like to have a copy.

LEEDS & NORTHRUP COMPANY

ELECTRICAL MEASURING INSTRUMENTS
POTENTIOMETER PYROMETERS—HUMP ELECTRIC FURNACES

4901 Stenton Avenue
PHILADELPHIA

320 Monadnock Block
CHICAGO

BLOW OUTS!

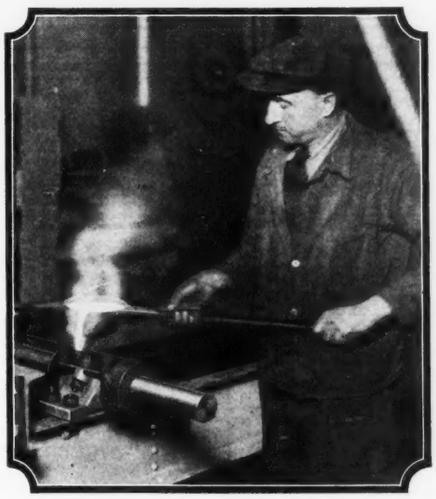
Can Now Be Eliminated by using... Babbitrite

AS NECESSARY AS THE LADLE

Men that use BABBITRITE

are better and more contented workmen for all the dangers of pouring molten babbitt metal have been eliminated. "BABBITRITE" is free from moisture, adheres to the work, will not dry out or harden and can be used for at least one hundred times, what more could you demand.

We have set aside a liberal sample for you which will be forwarded to you upon receipt of the coupon below.



BLOWOUTS are costly, mean injured workmen and tend to disrupt the workings of your entire shop. Men that handle molten babbitt metal are constantly in danger when using clay or putty as a retainer, due to moisture and melting. Why put your men in this dangerous position when by using "BABBITRITE", the common sense retainer, you pour all your bearings with absolutely no danger of any kind. "BABBITRITE" has many other sterling qualities besides safety, it comes to you ready to use, requiring no preparing or mixing, such as is necessary with clay or putty, it is unaffected by heat, it is moisture proof, it will not harden and it can be used innumerable times.

The fact that hundreds of large and small manfacturers are using "BABBITRITE" every day and have been using and reordering it for several years, emphatically proves that "BABBITRITE" is not just an ordinary retainer.

"BABBITRITE" is sold on a money back guarantee, we only ask that you give it a fair trial and put it to the severest tests you may wish. We shall be glad to help solve your babbitting problems or furnish you with further information and prices on "BABBITRITE".

SEND FOR SAMPLE

Without assuming any obligation, financial or otherwise, we will test the sample of Babbitrite which you may send to this address:

Firm Name .....

Address .....

City ..... State .....

Mark for attention of Mr. .....

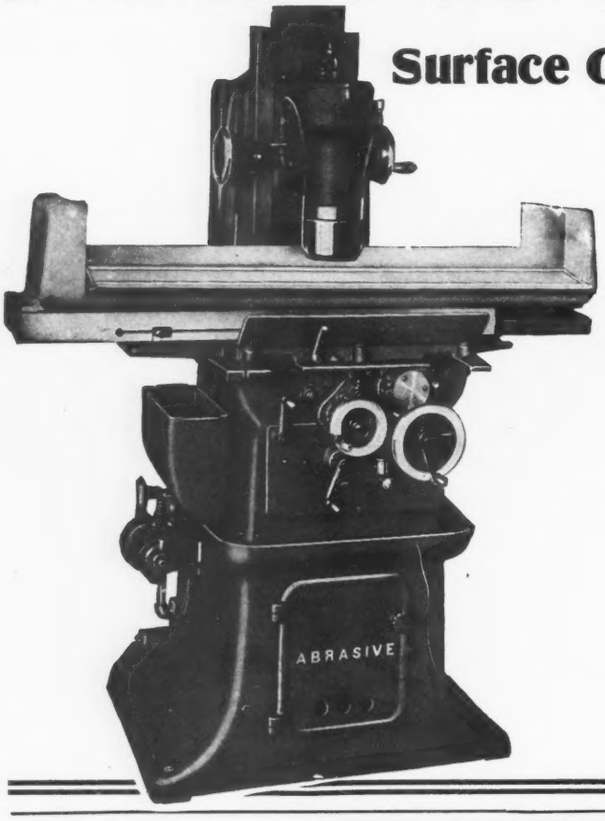
M-5-24

PRODUCTS MFG. & SALES COMPANY

MILWAUKEE, WISCONSIN

Babbitrite AS NECESSARY AS THE LADLE

ABRASIVE



Surface Grinding to Precision Limits

Speed on fine grinding is obtained by the Abrasive Surface Grinder. Unusually heavy, rigid, with unit cast frame, easily made adjustments and valuable operating conveniences make it valuable equipment in the tool-room, factory or contract shop—wherever grinding is done. May be equipped with specially designed attachments for unusual operations.

Ask us about Abrasive Grinding Machines

ABRASIVE MACHINE TOOL CO.
EAST PROVIDENCE, R. I.

Production and Accuracy go together on the

BLANCHARD SURFACE GRINDER

For dependable accuracy and steady, rapid production on

Cutter Blanks
Gear Blanks
Collars
Washers

there is nothing to equal the BLANCHARD

No. 16 Blanchard Grinder, 30" Chuck, grinding 4" High Speed Steel Cutter Blanks, removing 1/64" from each side, limits ±.0005", production 99 pieces (198 surfaces) per hour.

We make sizes and types for all shops and production requirements, large or small.

Send us your samples and blueprints today

THE SHOP THAT ADDS MODERN TOOLS AND SUBTRACTS THE OBSOLETE WILL MULTIPLY PRODUCTION AND HAVE PROFITS TO DIVIDE

THE BLANCHARD MACHINE CO.
64 State Street **Cambridge, Mass.**

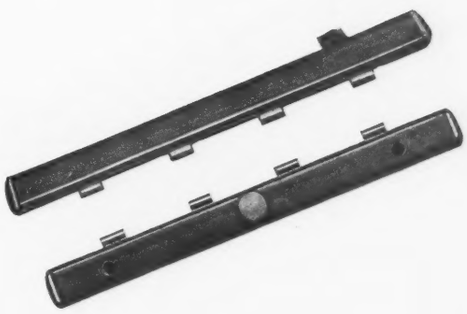
BLANCHARD

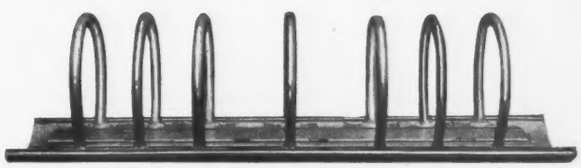
Divine Polishing Service

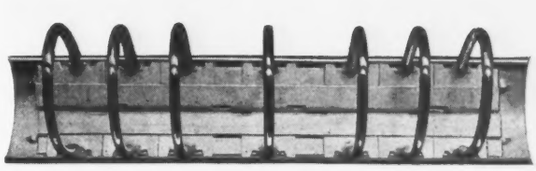
Covers all Phases of the Work

All the fine metal parts that go into the loose leaf devices made by the McMillan Book Company, Syracuse, New York, are finished with Divine Polishing and Buffing Wheels. Over one hundred Divine Wheels are used in this particular installation. On the work shown—finishing steel and brass rings and backs for loose leaf binders—Divine Compress Leather Wheels (on the machines and on the board) are used for polishing; Divine sewed buff and Spanish felt wheels are used for buffing.

Divine Polishing Wheels are carefully made and correctly balanced; Divine Polishing Service, by providing the *right* Divine Wheel for all phases of the work, insures uniformly excellent results and keeps finishing costs down to the minimum.







If you are puzzled, ask Divine experts—how to polish better, faster, at lower cost.

ENGINEERING DEPARTMENT

DIVINE BROTHERS COMPANY

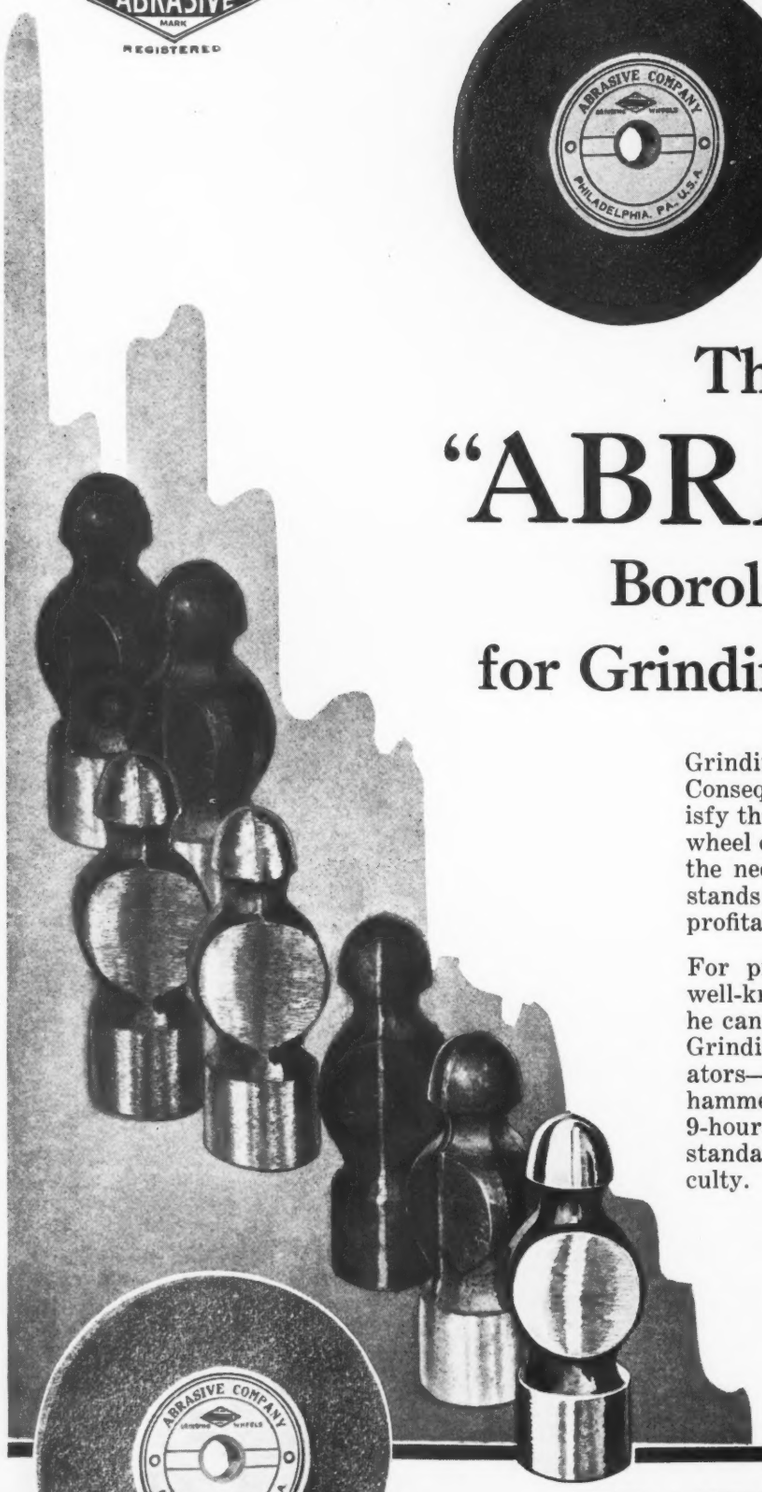
UTICA, N. Y., U. S. A.

Borolon and Electrolon

TRADE MARK TRADE MARK

TRADE ABRASIVE MARK REGISTERED

TRADE ABRASIVE MARK REGISTERED



They Use "ABRASIVE" Borolon Wheels for Grinding These Tools

Grinding small tools is a piece work job. Consequently it takes a fast wheel to satisfy the operators; a uniformly high grade wheel of the right grain and grade to meet the necessities of the work; a wheel that stands up well to make the operation profitable.

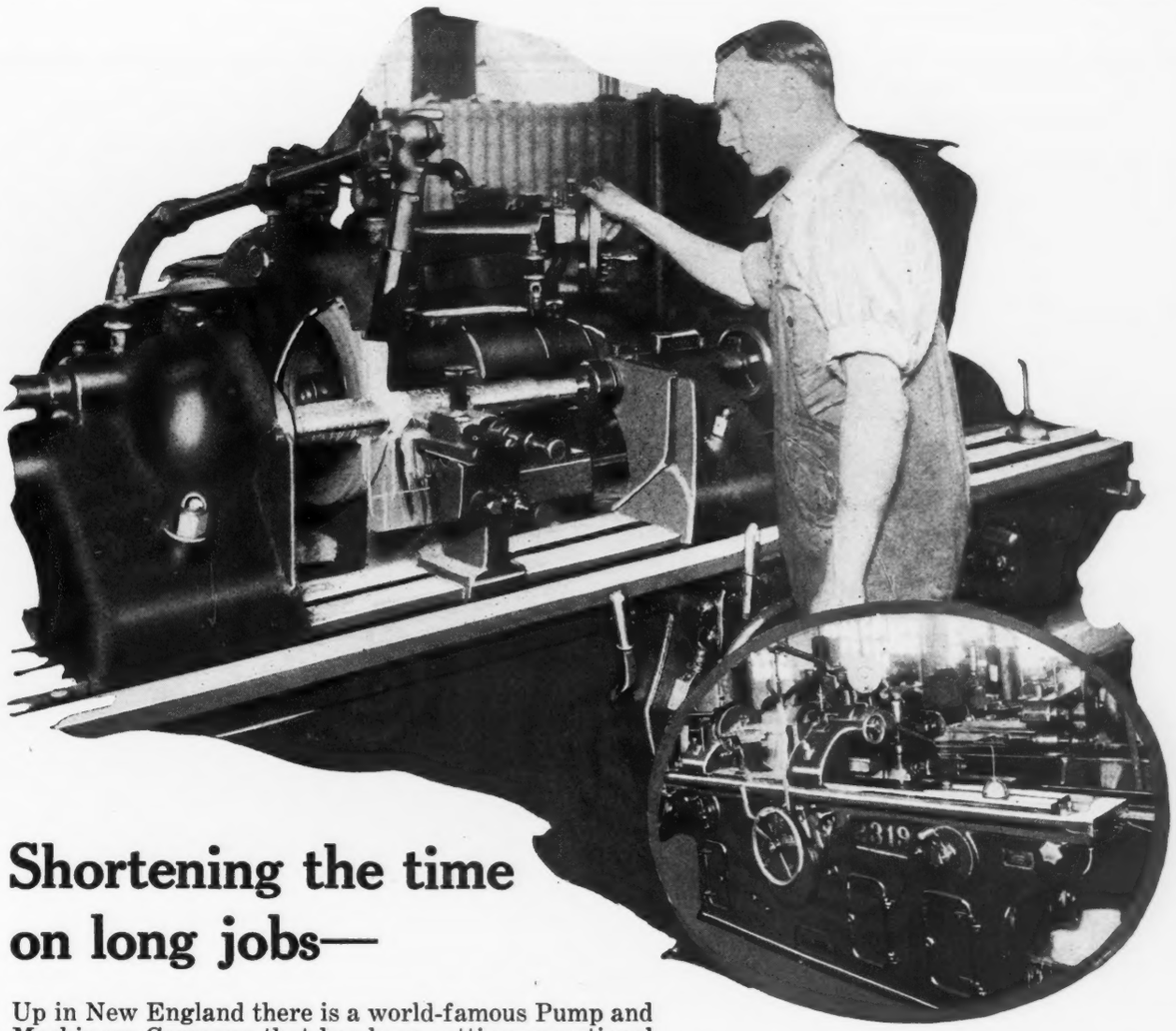
For production, finish and durability a well-known hardware manufacturer finds he cannot improve on "Abrasive" Borolon Grinding Wheels. They satisfy the operators—the man who grinds these ball peen hammers, for instance, finishes 300 per 9-hour-day—and they meet the high standards set for these tools without difficulty.

The right "Abrasive" Grinding Wheel secures maximum efficiency in grinding any class of work. Bring your problems to "Abrasive" experts for solution.

Send for the "Abrasive" catalog.

ABRASIVE COMPANY

Bridesburg, Philadelphia 566 Washington Blvd., Chicago



Shortening the time on long jobs—

Up in New England there is a world-famous Pump and Machinery Company that has been getting exceptional results—in both production and precision—from five LANDIS *Grinding Machines* for the past six years.

Long work, shafts and piston rods, are ground to close limits at a big time saving over former methods and LANDIS dependability practically eliminates rejects.

At the top of this space, we show the LANDIS finishing a hardened steel Piston Rod. From .008 in. to .010 in. stock is removed, holding to limits of ± .0005 in.

Thirty-five of these Rods are LANDIS ground each working day.

LANDIS Grinding Machines have made big advances in machining practice. They find full favor from operator, production man and inspector.

Tell us something about your grinding work and we will suggest methods for improvement.

LANDIS

Cylindrical Grinders

LANDIS Tool Company, Waynesboro, Penna.

New York Office, 30 Church Street

Chicago Office, 618 W. Washington Blvd. **Detroit, Office, 5928 Second Blvd.**

DOMESTIC AGENTS: Hallidie Machinery Co., Seattle; Smith, Booth, Usher Co., San Francisco and Los Angeles; Peden Iron & Steel Co., Houston; Fulton Supply Co., Atlanta; F. C. Richmond Machinery Co., Salt Lake City. **CANADIAN AGENTS:** F. F. Barber Machinery Co., Toronto; Williams & Wilson, Ltd., Montreal.

FOREIGN AGENTS: R. S. Stokvis & Zonen, Rotterdam; R. S. Stokvis & Fils, Paris; Ing. Ercole Vaghi, Milan; Andersen, Meyer & Co., Ltd., Shanghai; Andrews & George Company, Ltd., Tokyo; Benson Brothers, Sydney & Melbourne; Burton Griffiths & Co., Ltd., London; Wilh. Sonesson & Co., Malmo and Copenhagen.

LANDIS

DIAGNOSING FOUNDRY GRINDING CONDITIONS

THE days of hit or miss grinding in the foundry are over.

Today it is just as necessary to get the right wheel in the right place for the snagging or rough grinding job as it is in precision work.

A close study—a diagnosis if you will—of the grinding conditions in any foundry is what is needed to get the most and the best out of your wheels.

And we stand ready to lend a help. We will be glad to send the trained men of our sales engineering department to take off their coats and work with your men. They will bring test wheels for trial. They will stay right on the job to determine just which is the wheel to increase your production, to lower your grinding costs, to better your grinding results.

If these things can be done we are certain that our wheels and our men can do them.

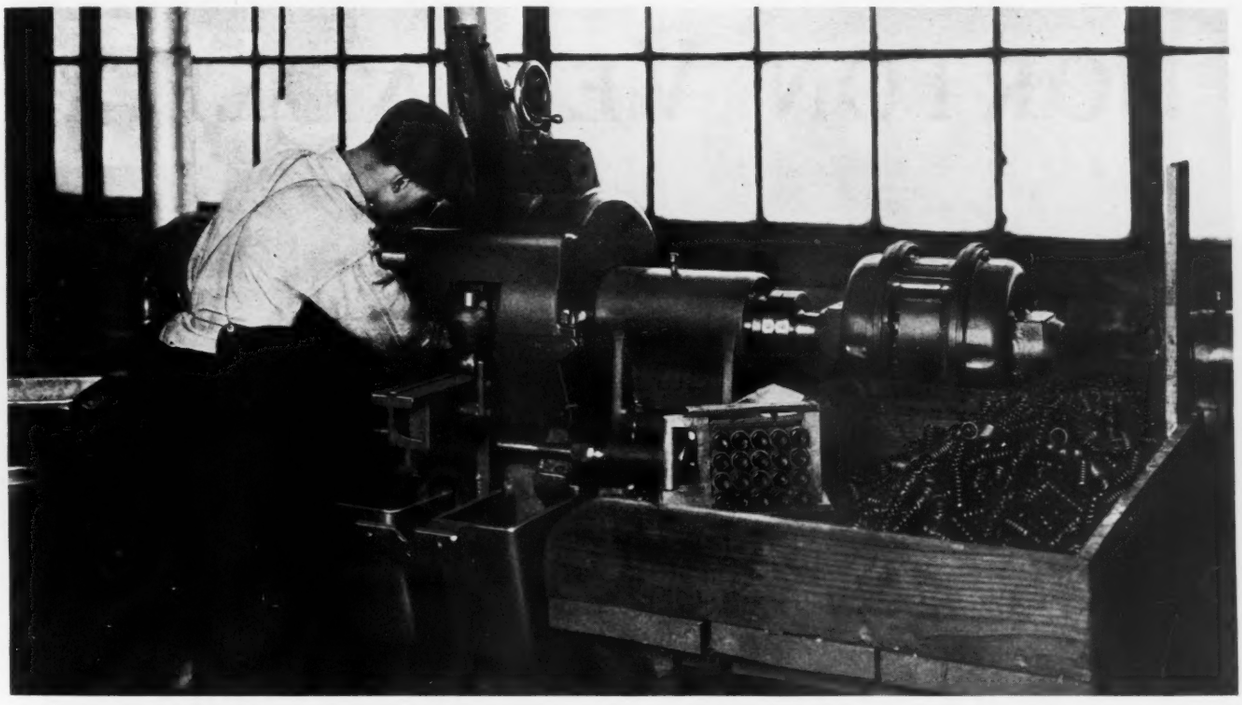
If your work is on grinding steel or malleables, Aloxite Grinding Wheels will be recommended—for cast iron, Carborundum.

WILL YOU GIVE US A CHANCE TO WORK WITH YOU?
WRITE OUR SALES ENGINEERING DEPARTMENT TODAY

Carborundum Service is at Your Service

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N.Y., U.S.A.

New York, Chicago, Boston, Philadelphia, Cleveland, Cincinnati, Detroit, Pittsburgh, Grand Rapids, Milwaukee
Canadian Carborundum Company, Ltd., Niagara Falls, Ont.



The grinding of coil springs—

an operation especially adapted to the new Gardner No. 27 Oilgear Feed Double Spindle Disc Grinder.

THE OILGEAR HYDRAULIC FEED feature of this machine affords that perfect, definite control of grinding pressure and rate of feed so essential if perfect results are to be secured in the grinding of this particular product.

The metal work holder carrying the springs is mounted on a mechanically operated swinging fixture, enabling the operator, once he has clamped his holder in place and actuated the feed of the machine by a touch on the handily-located control lever, to devote his time entirely to the loading of a second work holder.

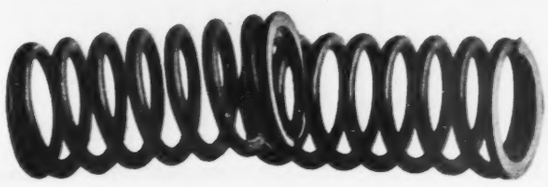
A high quality of work produced, turned out at a rapid rate of production, is the result of the use of this new Double Spindle Disc Grinder by the large manufacturer of coil and flat springs in whose factory the above photo was taken.

The No. 27 Oilgear Feed Gardner Disc Grinder is adapted to a wide variety of parts requiring the finishing of opposite parallel surfaces, and it has proved far more economical than the standard type of double head Disc Grinder.

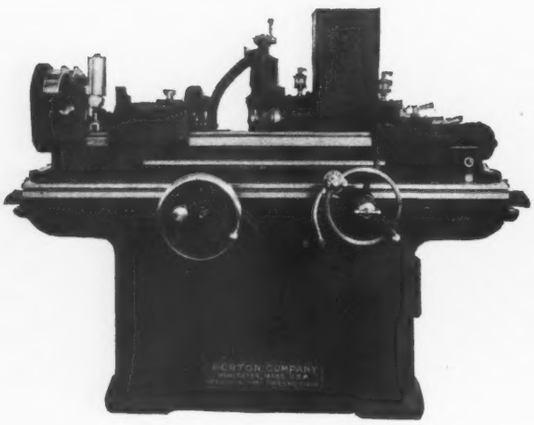
Ask for our new 8 page bulletin!

GARDNER MACHINE CO.
414 E. Gardner St., Beloit, Wis.
U. S. A.

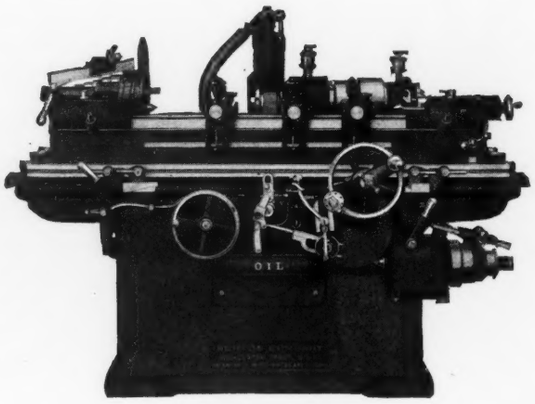
GARDNER DISC GRINDERS



NORTON VERSATILITY



Single Purpose Stripped Machine



Power Table Traverse Machine

Norton Cylindrical Grinding Machines

are both

"Single Purpose"

in their producing ability

and

"General Purpose"

in their adaptability.

Economy in the purchasing of machine tools requires that you get the best machine for the purpose, and when that purpose is accomplished they can be easily made equally efficient for the next job.

When no longer needed on the job for which they were originally purchased they can be readily changed over so as to be specially adapted for some other kind of work and save the purchase of another tool.

NORTON COMPANY

WORCESTER, MASS., U. S. A.

New York Chicago Detroit Philadelphia
Cleveland Syracuse Hartford

M-115

Performance!

Take a lot of reports of Sterling Wheel tests, figure them up and the difference between Sterling wheels and the other makes of wheels is seldom under thirty per cent.

For example:

A large motor plant 32% increase. Automobile plant Sterling wheel finishes 345 cylinders against best competitor's 280. Grinding transmission cases, other wheels ran 122 hours while Sterling wheels ran 166 hours.

There are numerous cases where the increase has been as high as **three hundred per cent**—plenty of them thirty per cent or more. There are so many of these that the most hard shelled doubting Thomas would soon throw up his hands and yell, "enough."

And you can be sure that these extraordinary results are not chance happenings—they are the result of applying years of knowledge and experience to all forms of grinding. These economies can be had in your plant just as readily as in the other fellow's plant. All you need to do is to call in a Sterling Grinding Engineer—he will quickly show you!

The Cleveland Stone Company

Artificial Abrasive Division

Cleveland, New York and Boston

Factory: Tiffin, Ohio **Office: Cleveland, Ohio**

STERLING ABRASIVES

AND STERLING GRINDING MACHINES

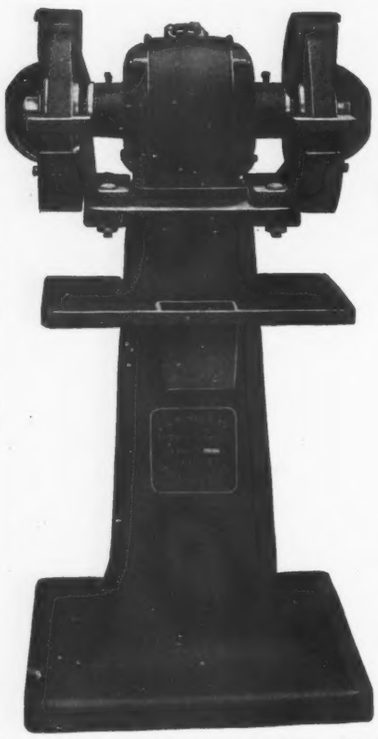
A Helpful Booklet Sent Free

"The Art and Science of Grinding" is a booklet packed from cover to cover with useful, helpful, practical information about grinding. A copy is free for the asking.

What Do You Know About Grinding?

This is a booklet containing the answers to forty questions about grinding—all written by an expert. A copy is free for the asking.

BLOUNT

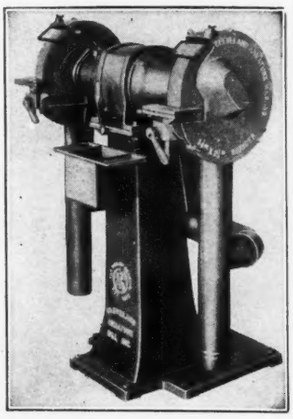


Ball-Bearing Motor Grinders

Built in 7 Sizes— ¼ to 5 H.P.

J. G. BLOUNT COMPANY
CENTRAL AVENUE EVERETT, MASS.

Announcing the
C. A. W. Grinders, Buffers



Polishers, Tire Buffers, equipped with Timken Tapped Adjustable Roller Bearings. The products of 28 years' experience. Made in all sizes and types. Liberal long term payment plan. Some dealers' territory still open.

Cleveland Armature Works, Inc.
4732 St. Clair Ave.
CLEVELAND OHIO

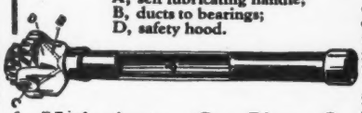
Emery Wheel Dressers
Two Sizes Nos. 1-2

CUTTERS

We make the regular Huntington (Pattern) for all sizes. Roughing for Nos. 1 and 2. Paragon for No. 1 only.

GEO. H. CALDER CO., Lancaster, Pa., U.S.A.

GRINDING WHEEL DRESSERS AND CUTTERS

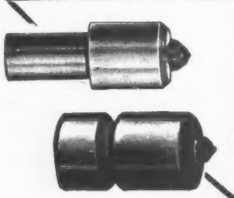


A, self lubricating handle;
B, ducts to bearings;
D, safety hood.

"Yellow Head" Self-lubricating Dressers meet requirements because the spindle is lubricated with graphite and keeps the cutter bearings from wearing. Tests show cutters used in this handle last two to three weeks longer than in a plain bearing handle.

Hetherington Co., Piqua, O.

Francis Diamond Grinder Tools



The best stones correctly set are indispensable for truing fine grinding wheels. An assortment of Francis diamonds and tools for selection will guarantee you high quality, durable stones in well made holders of the wanted types. Diamonds carefully reset by experts.

Write us.

FRANCIS & CO.
First National Bank Bldg.
50 State St., Hartford, Conn.
Established in 1799

Small Tool and Grinding Equipment

Taps and Dies, Screw Plates, Drills and Reamers, Milling Cutters, Pipe Tools. Also Pipe Threading and Cutting Machines.
"Hydroil" Internal Grinders, GTD Cutter and Reamer Grinders. Catalog on request.

REG. U.S. PAT. OFF. GTD

GREENFIELD TAP & DIE CORPORATION, GREENFIELD, MASS.

Grinding and Polishing Machinery

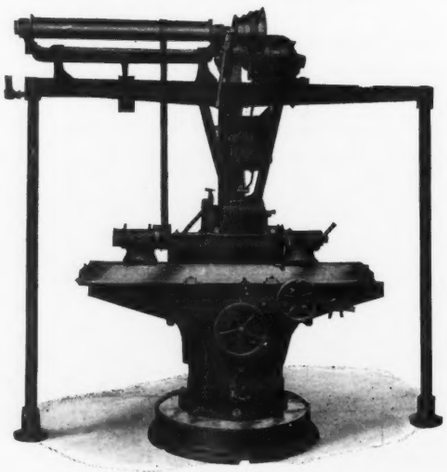
Diamond Machine Co.
Providence, R.I., U.S.A.

Set a Thompson Up Anywhere

This specially designed countershaft support makes it easy to set up the Thompson Universal Grinder without the use of overhead countershafting. It saves belting and insures efficient machine operation.

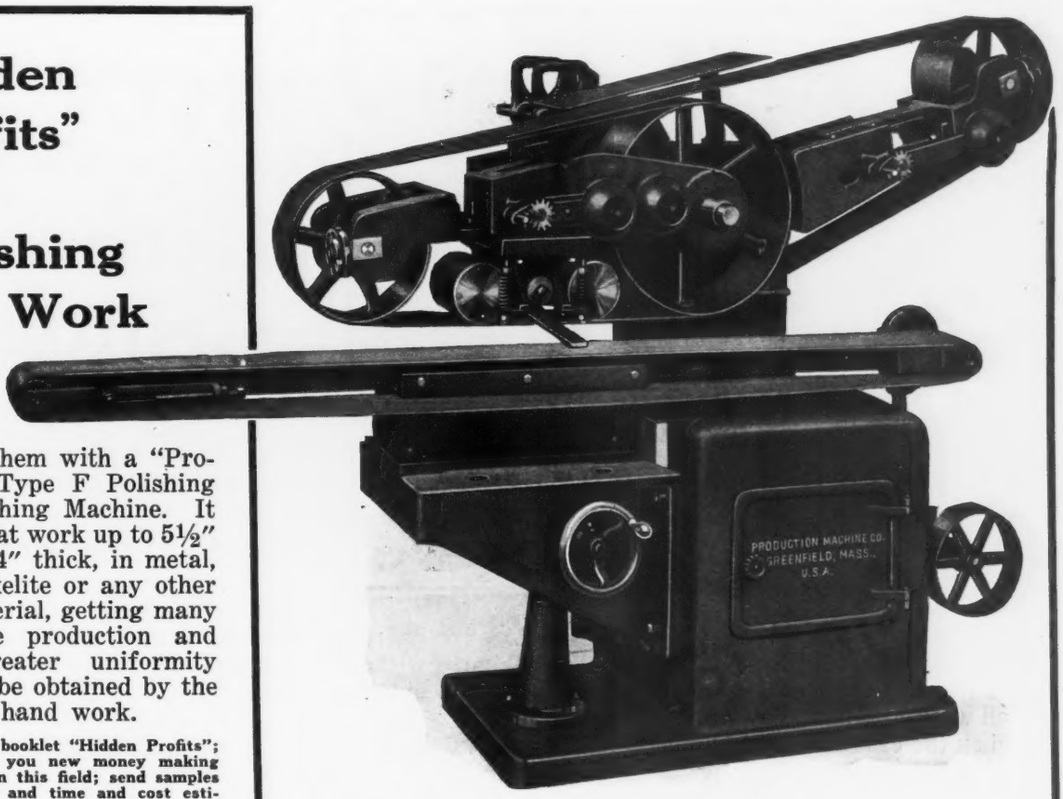
The machine is our standard type 10″ x 36″ Universal Grinder for Surface, Cylindrical, Internal, Knife, Edge or Die Grinding.

Send for Circular 14 for details.



THE THOMPSON GRINDER CO.
SPRINGFIELD OHIO, U. S. A.

"Hidden Profits" in Finishing Flat Work



Uncover them with a "Production" Type F Polishing and Finishing Machine. It polishes flat work up to 5½" wide, by 4" thick, in metal, wood, bakelite or any other hard material, getting many times the production and much greater uniformity than can be obtained by the speediest hand work.

Send for the booklet "Hidden Profits"; it will show you new money making possibilities in this field; send samples for polishing and time and cost estimates.

PRODUCTION MACHINE CO., Greenfield, Mass., U. S. A.

Motch & Merryweather Machinery Co., Cleveland, Pittsburgh, Cincinnati. W. C. Lynn, 2152 Fullerton Ave., Detroit. John R. Conick, 7405 Colfax Ave., Chicago. Allied Machinery Company of America, New York City (Export).

Why Buy Diamonds?

Diamo-Carbo Emery Wheel Dressers are low cost wheel dressing tools that are efficient for use on all but the hardest, coarsest wheels. Keep one at every machine.

Send for catalog of Huntington, Sherman, Magazine and Special Dressers and our new Desmond-Hex Dresser. Quality diamonds in stock for selection.

The Desmond-Stephan Mfg. Co.
URBANA OHIO, U. S. A.
The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont. Alfred Herbert, Ltd., Coventry, England, Agent for Great Britain.

Sharp Tools Mean Better Work and Better Profit

Don't let a lot of dull tools gather—sharpen them as they come from the machines, on the Woods Tool and Cutter Grinder, and you'll have an ever-ready supply of sharp tools that will turn out better work, which of course, means better *profit*.

Woods equipment includes full complement of attachments, swings work up to 9" by 16".

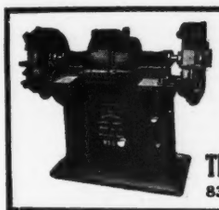
No obligation for information—write

WOODS Universal Tool and Cutter Grinders

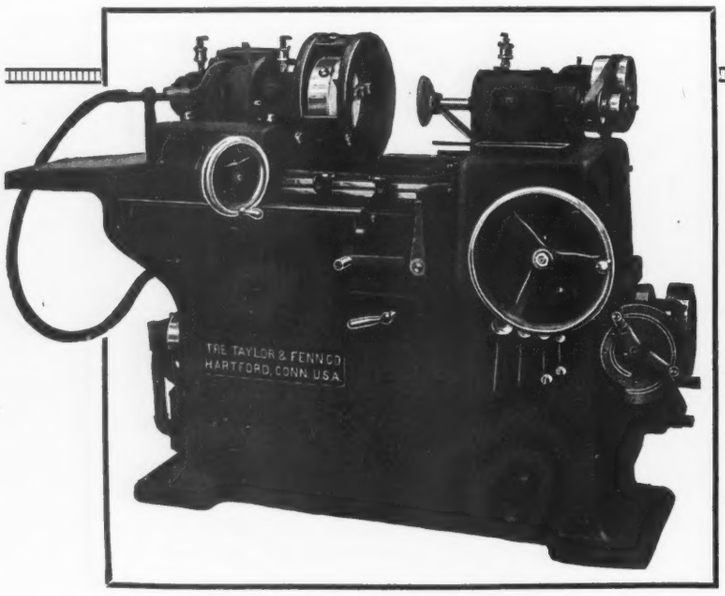
Made in Three Sizes

WOODS ENGINEERING CO.
ALLIANCE OHIO, U. S. A.

INDUSTRIAL-DIAMONDS
WHEEL TRUEING TOOL CO.
DETROIT
New York-Chicago-Cleveland-Los Angeles-Walkerville Ont.



BRIDGEPORT GRINDERS
Properly mounted bearings is one reason for the superiority of Bridgeport Grinders. Large spindles with four sets of ball bearings to each spindle.
Let us send catalog of our grinding and polishing equipment.
The Bridgeport Safety Emery Wheel Co., Inc.
83 Knowlton Street, Bridgeport, Conn.



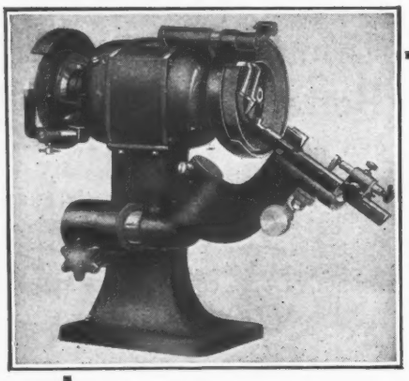
The Taylor & Fenn Bore Grinder

Better Production
Greater Accuracy
Lower Costs

THE simplicity, power and rigidity developed in the design and construction of this machine make it the solution of the bore grinding problem on all work within its range. The wheel-head, set rigid on the base and without slides or loose parts, enables the spindle (running in large sized ball bearings) to be operated at 5000 to 25,000 R.P.M. without vibration. The work-head is the moveable member and is bolted directly to the cross-slide. Table and cross-slide are self-adjusting on large V and flat ways—giving quick, accurate adjustments of the work to the grinding wheel.

Capacity to 8 inch deep; 8 inch diameter. If you want production in this range ask about this machine.

The Taylor & Fenn Co., Hartford, Conn., U. S. A.



Two Ways to Save Money

The Grand Rapids Drill Grinder grinds drills accurately and quickly *at minimum cost.* Correctly ground drills stay sharp longer, wear better and do better work; they cut drilling costs by reducing the number of drills necessary to do a given amount of work.

The Grand Rapids Tap Grinder insures correctly ground taps that cut clean threads with minimum breakage. Cut *your* tapping costs by keeping taps right on this machine.

Gallmeyer & Livingston Co.
344 Straight Ave., S. W., Grand Rapids, Mich.

BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD, VERMONT

Reg. U. S. Pat. Off.

Builders of

Hole Grinders
Hole and Face Grinders
Deep Hole Grinders

MARSCHKE for Grinding Economy

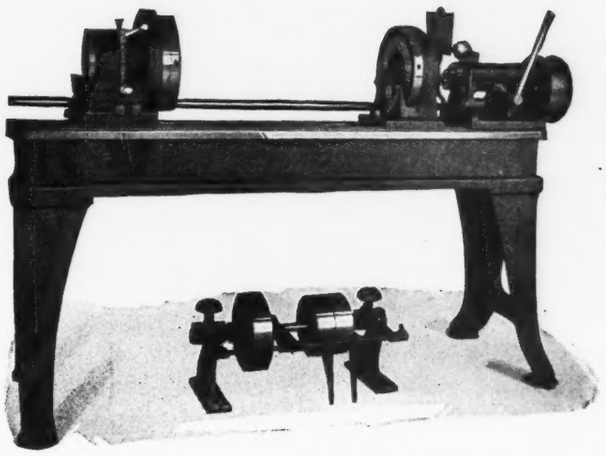
Marschke Grinders economize on power. Motor reaches full speed in 4 seconds, and power stops the instant operator removes his foot from treadle.

Fully self-contained equipment, with ball bearings liberally used throughout, motor bearings independent from outboard bearings.

Let us tell you about these "Economy" machines.

Marschke Mfg. Co.
INDIANAPOLIS, INDIANA, U.S.A.

THE WHITON
Revolving Centering Machine



For Accurately Centering Finished Shafts

The cut shows new *Revolving Centering Machine* — a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machines and embodies all the special features.

Circulars and prices sent upon application.

THE D. E. WHITON MACHINE COMPANY
NEW LONDON, CONNECTICUT, U. S. A.

Broaching Machines and Broaches

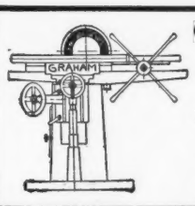
Years of experience in the successful manufacture of broaching equipment assure you of up-to-date, progressive methods and tools when you buy broaches or broaching machines from the J. N. Lapointe Company of New London.

We'll be glad to quote costs and give you complete information on any broaching proposition.

J. N. LAPOINTE CO. of New London, Conn.

BADGER TOOL COMPANY
Grinding Machinery
Supplies and Accessories

E. B. GARDNER, President R. D. GARDNER, Treasurer
BELOIT, WISCONSIN, U. S. A.



GRAHAM GRINDERS
KNEE TYPE—RING WHEEL
for Flat Surfaces
NEW PULLEY GRINDER
For finishing pulleys, shallow circular and curved work.
THE GRAHAM MFG. CO.
Providence, R. I.
Stockton & Bunn, Ltd., London

RANSOM GRINDERS
Ball Bearing—Heavy Duty

ALL SIZES TO 15 H. P.

Details Gladly Furnished

RANSOM MANUFACTURING CO.
Oshkosh, Wis., U. S. A.

Rowbottom for Cams

Accurate Cams at *Low Cost*

The simplicity and convenience of the Rowbottom Cam Milling Machine make it possible for this young operator to handle the work without difficulty in spite of his lack of inches.

The cams shown were cut in our contract shop; the small ones for a well-known manufacturing company building its own special machines. The larger cam is of steel 8″ in diameter, 7″ long, with two cam paths 1½″ wide and 1½″ deep.

In every case the accuracy of Rowbottom Cut Cams insures the efficient performance of important operations.

Let us tell you about the Rowbottom Cam Milling Machine or quote prices on cutting your cams in our contract shop.

The ROWBOTTOM MACHINE CO.

Factory: Waterville, Conn.

WATERBURY, CONN. U. S. A.

Short Story of a Big Achievement—

THE story of a machine which saves money. For all plants—small, medium, and large. A simple machine. A reliable machine. An efficient machine. One which reduces operating and production worries.

SIMPLICITY—the true test of a designer's ability. A machine that is simple is also easy to operate. Experienced labor is not required. There are no complicated mechanisms. Interruptions in production schedules are avoided.

RUGGEDNESS—next of kin to Simplicity and equally important. It guarantees long life. It keeps repair costs low. It is proof that the parts are properly proportioned—every pound of metal is worth the money spent for it.

EFFICIENCY—the measuring stick of engineering. The standard of exact comparison. Not mechanical efficiency—not electrical efficiency, but high over-all efficiency. Sustained Efficiency.

RELIABILITY—best guaranteed by the reputation of the builder. A most important characteristic in a man and a no less essential one in a machine. A reliable product is one that has proved itself. You do not gamble with your money or risk your production when you use such a machine.

INGERSOLL-RAND 50 HP AND 100 HP STATIONARY OIL ENGINES

Simple, Rugged, Efficient, Reliable.

A small engine that makes for big savings.

Four cycle, horizontal, having direct-injection of fuel. Starts cold. No high pressure injection air compressor and piping. No hot bulbs or electrical ignition.

A small oil engine operating with full Diesel economy at any load. Burns any fuel oils that can be used in any Diesel engine. Burns *all* oil injected into cylinder—thus insuring *sustained* high over-all efficiency. No pulling of pistons, no scraping of valves, no needless wear.

Let our engineers explain the details and convince you of the savings.

INGERSOLL-RAND COMPANY-11 BROADWAY, NEW YORK CITY.
Offices in all principal domestic and foreign cities.

Ingersoll-Rand

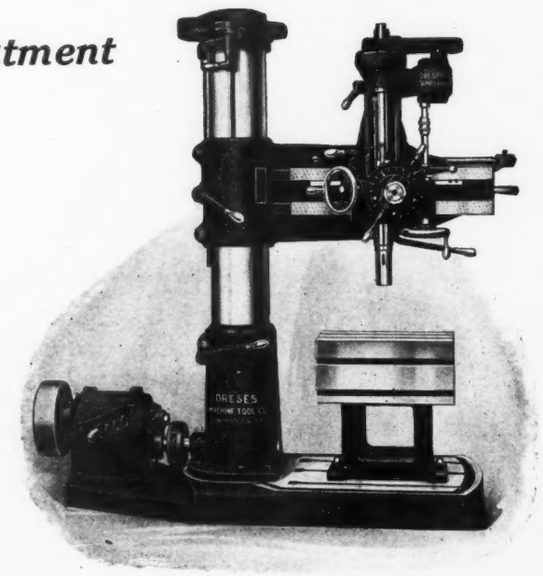
OUR NEW 2½ AND 3 FT.

SIMPLEX RADIAL DRILLS

"Stand Up" Under Hard Treatment

Built for heavy duty, unskilled hands, and places where complicated or delicate tools are undesirable. All mechanisms are simplified to the last degree. This reduces general wear and tear, greatly lessens the chances for sticking, breaking or other trouble, and makes oiling easy.

While these machines lack none of the modern features essential for convenient control and rapid production—the price is low enough to bring a really good Radial Drill within reach of every user.



Built in connection with our 3 to 7 ft. Plain and 4 to 7 ft. Half and Full Universal High Duty Radials

THE DRESES MACHINE TOOL COMPANY

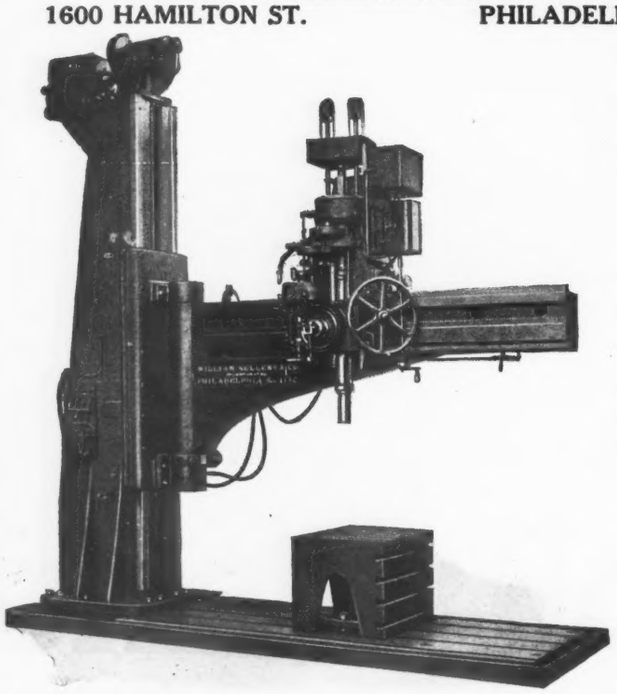
Cincinnati, Ohio

William Sellers & Co. Incorporated

ESTABLISHED 1848

1600 HAMILTON ST. PHILADELPHIA, PA.

LABOR SAVING MACHINE TOOLS



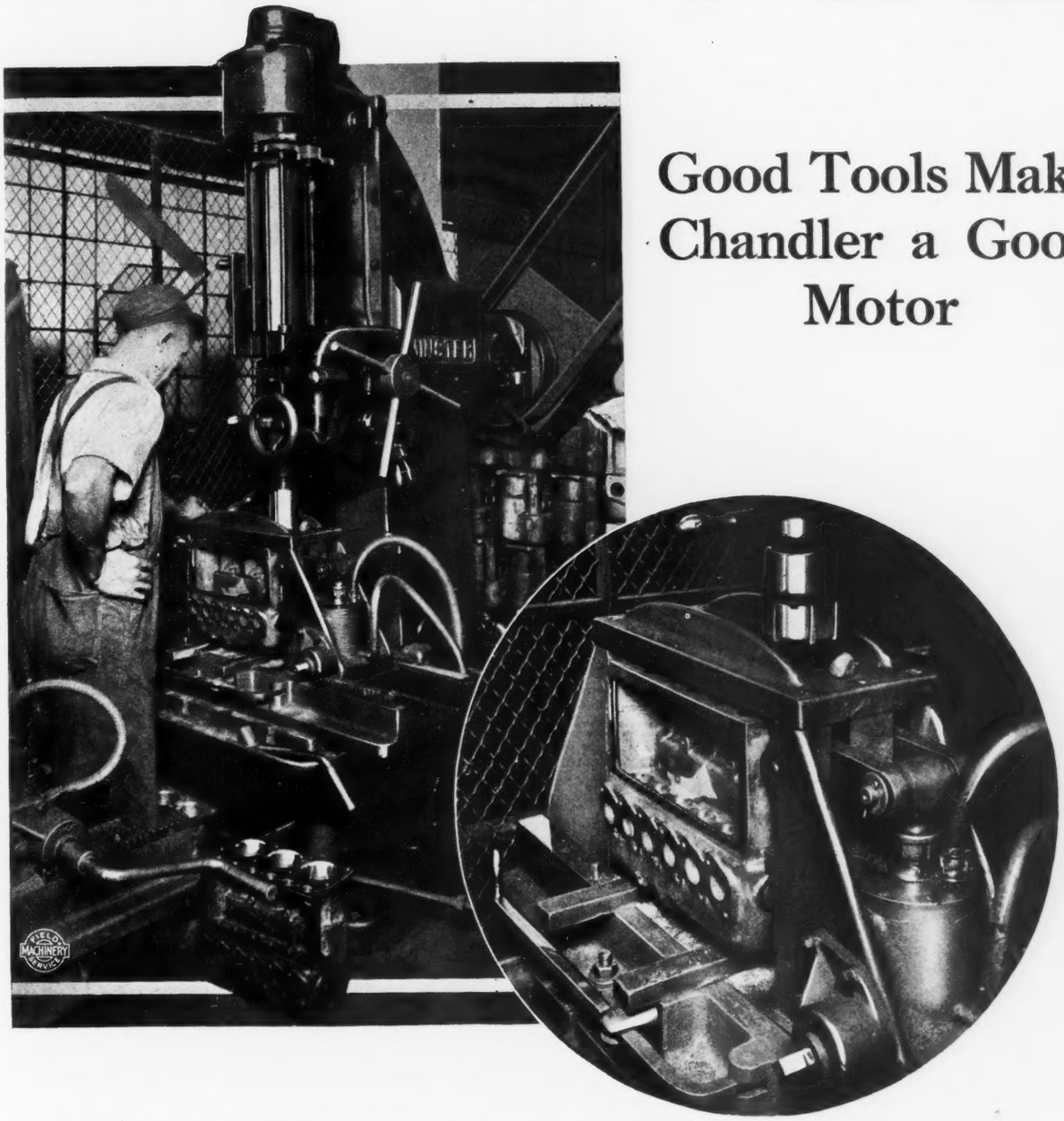
RADIAL DRILL
Direct Geared Head

Driving motor carried on back of head, counterbalancing drilling mechanism, and connected to spindle through spur gearing. Spindle 3¼" diameter, 15" stroke, carried close to face of radial arm, reducing twisting tendency to minimum. Pneumatic locking device for arm. Power pump and circulating system for lubricant. Means for controlling various movements within easy reach of operator from working position.

Convenient arrangement, ease of operation and high production distinguish this drill.

TOOL GRINDERS INJECTORS SHAFTING DRILL GRINDERS

MINSTER



Good Tools Make Chandler a Good Motor

Four Minster Drills produce parts for the well-known Chandler automobile. It's a case of using good tools to produce a good car.

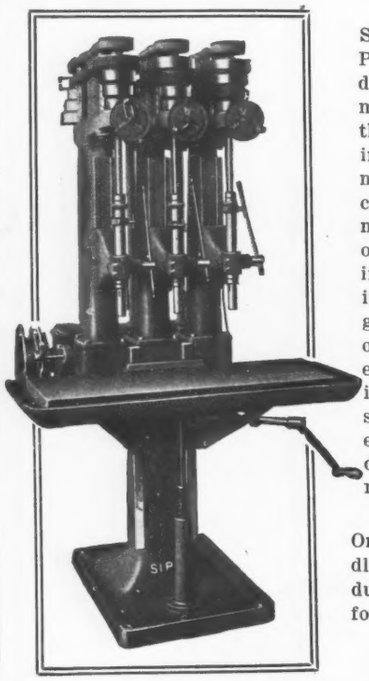
For five years the machine shown above has been reaming cylinders for the Chandler engine. The cylinder blocks are secured in a fixture, and after each reaming operation the fixture is indexed to the next position. The cylinders are 3½″ in diameter by 9″ deep. The Minster finishes each cylinder in 3 minutes.

Perhaps there is an operation in your plant on which Minster Drilling would improve time, quality or cost. Why not investigate?

"Minster Drilling is Limit Drilling"

THE MINSTER MACHINE COMPANY, Minster, Ohio

For Fast Drilling



Sipp Sensitive Drill Presses are production drilling machines that pay their way. By eliminating all waste motions speed changes can be made in two seconds, belt changes in ten. Ball bearings, transmission gears running in oil and general operating efficiency insure speed and smoothness to every motion and reduce wear to a minimum.

One to eight spindles—if you do production drilling write for details.

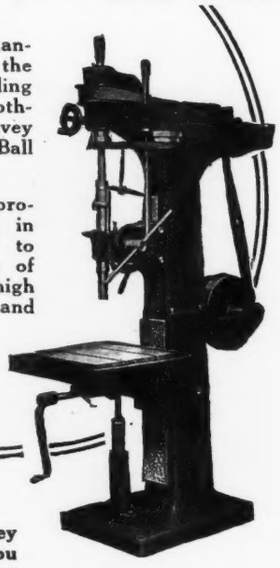
The Sipp Machine Co.

Paterson, New Jersey

It Will Increase Production

To increase the quantity and improve the quality of your drilling operations there's nothing can beat the Avey No. 3 Heavy Duty Ball Bearing Driller.

A 50% increase in production is possible in the drilling of ¾" to 1⅛" holes because of the exceptional high speeds employed and range of feeds.



Avey

When you install an Avey you get a machine that you know is going to give you superior work at lowest possible cost. The Avey Catalog will help on your drilling problems.

This machine is built in combinations up to six spindles, hand or power feed.

The Avey Drilling Machine Company

Cincinnati, Ohio, U. S. A.

It's the "Low Hung Drive"

—that gives the Western Radial such unusual cutting power. Putting the driving gears in the right place—the lower end of the spindle—applies power to the drill with minimum loss and no torsional strain.

Send for details of Western Radial Construction.

WESTERN MACHINE TOOL WORKS

**Holland, Mich.
U. S. A.**

Eliminate Special Fixtures

The money saved by the new 20" Rockford Box Column Drilling Machine in the elimination of special fixtures alone more than pays for its installation.

This machine performs three successive operations with a common center in any odd shaped parts within its capacity—fast, accurately and economically.

Let us give all the facts.

The Rockford Drilling Machine Co.

ROCKFORD ILL., U. S. A.

DRIVES RIVETS AT HIGH SPEED

Townsend Riveters are of the multiblow type, made in 27 models and sizes. Capacity, rivets up to 5/16".

The Townsend Drill Press is a new manufacturing machine that provides for operation with both hands free, making for very fast handling of work. Can be operated at extremely high speeds.

May we send details?

H. P. Townsend Mfg. Co.

5 Chestnut St. Hartford, Conn.

Do Multiple Drilling

without Expensive Equipment

You can do just as fast and efficient multiple drilling with your single spindle drill press as the fellow who spends a pile of money for multiple spindle presses.

U. S. Multiple Drill Head

slipped on the spindle of your single spindle machine, immediately converts it into a highly efficient multiple press that will drill 2, 6 or a dozen holes in the time it takes to drill one.

U. S. Drill Heads are built according to the most advanced engineering methods, particular care being given to relation of spindle speeds to drill press and hole sizes.

Standard line always in stock, special heads like the one shown, to order.

The price is but a fraction of the cost of a multiple spindle drilling machine.

We'll be glad to prove our claims to your complete satisfaction

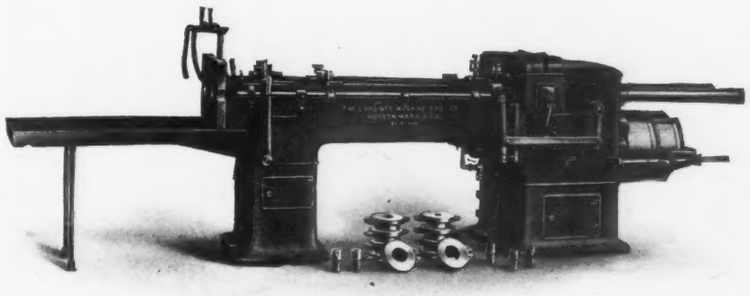
UNITED STATES DRILL HEAD COMPANY

1948 West Sixth Street **CINCINNATI, OHIO, U. S. A.**

Double Quick on Broaching—

Draw rods operated independently, with independent speeds and feeds, give the new Lapointe Improved Duplex Broaching Machine double the production capacity of a single machine *without increasing labor cost.* Power consumption, upkeep, etc., is so little higher that costs have been reduced as much as 80% in many instances.

The New Lapointe Improved Duplex Broaching Machine



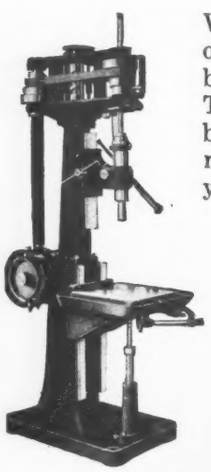
A new machine by "Lapointe of Hudson" is always a step ahead. Let us tell you about the Improved Duplex

LAPOINTE MACHINE TOOL CO., Hudson, Mass.

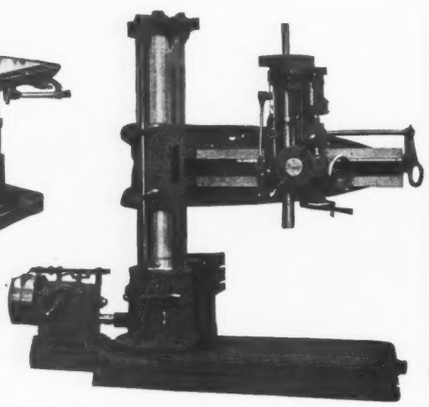
FOSDICK

These are Different and Better Drills

Many features of Fosdick Drilling Machines are distinct helps to better, faster drilling. The hand feed can be used ahead of power feed for starting large drills. Feed changes are accomplished by a single lever, an overtake clutch eliminating shock.



We've put part of the story of Fosdick Drilling in our booklet; send for a copy. The rest of the story is told by Fosdick performance in many shops—why not in yours?



Radials—All geared, High Speed to Heavy Duty, 2 to 6 ft., capacity 3/16" to 4" drills. Balanced Arm, motor driven, 4 to 6 ft. High Speed Sensitive, 3, 3½ and 4 ft. for drilling and tapping, capacity to 1".

Uprights—21" to 30". Capacity 3/16" to 3".

Ball Bearing Sensitives—13" to 24", 1 to 8 spindles, capacity to 1".

THE FOSDICK MACHINE TOOL COMPANY

CINCINNATI, OHIO, U. S. A.

AGENTS:

Colcord-Wright Machinery & Supply Co., St. Louis, Mo. Barbour, Love & Woodward, New York, N. Y. E. A. Kinsey Co., Cincinnati, Ohio, Indianapolis, Ind. Peninsular Machinery Co., Detroit, Mich. Homer, Strong Co., Rochester, N. Y., Buffalo, N. Y. H. A. Smith Machinery Co., Syracuse, N. Y. Swind Machinery Co., Philadelphia, Pa. Somers, Fitler & Todd Co., Pittsburgh, Pa. Stocker-Rumely-Wachs Machinery Co., Chicago, Ill., Milwaukee, Wis. Taylor Machinery Co., Boston, Mass. A. R. Williams Machinery Co., Toronto, Ont., Canada. The Mine & Smelter Supply Co., Salt Lake City, Utah. Moore-Handley Hardware Co., Birmingham, Ala. Waterhouse & Lester Co., San Francisco, Calif. Eccles & Davies, Los Angeles Calif. The Cleveland Tool & Supply Co., Cleveland, Ohio. Bay Verte Machinery Supply Co., Green Bay, Wis. Burton, Griffiths & Co., London, England. Fenwick Freres Co., Paris, France. Wynmalen & Hausman, Rotterdam, Holland. Rylander & Asplund, Stockholm, Sweden. Wilh. Sonesson & Co., Malmo, Sweden, Copenhagen, Denmark.

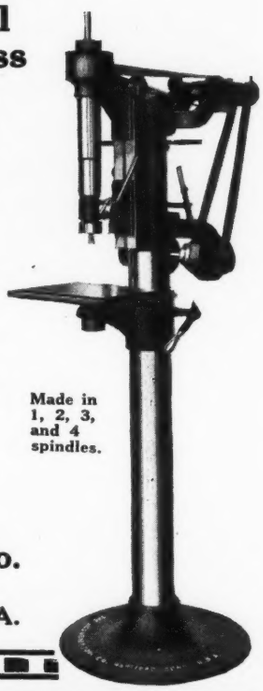
It brings you the most in return

The equipment which turns out work of the highest quality and performs regularly without repairs will bring you the most in return for the money it represents.

A Sigourney Ball Bearing Drill Press

Turns out work of the highest quality — you take no chances with it. This drill press keeps the quality of its output high to the end of its exceptionally long life.

Has 2 5/16" vertical movement by means of a lever; fitted with No. 1 Morse Twist Drill Taper; 3 speeds; adjustable stops and many other excellent advantages. Drills from 0 to 5/16" diameter, and to ½" when No. 1 Morse shank Drill is used. Shipped belted ready to use.



Made in 1, 2, 3, and 4 spindles.

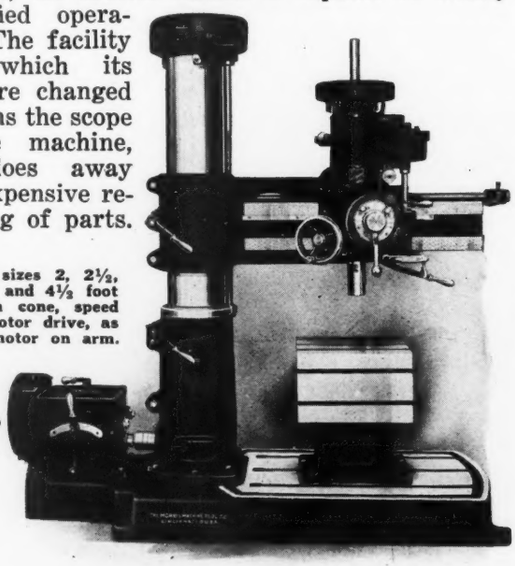
We'll be glad to send full details.

The Sigourney Tool Co.
11 Sigourney Street
Hartford, Conn., U. S. A.

All in a Single Unit

If you need equipment to perform a wide range of drilling, tapping, facing and counterboring get the Morris Radial; it gives you all this in a single unit.

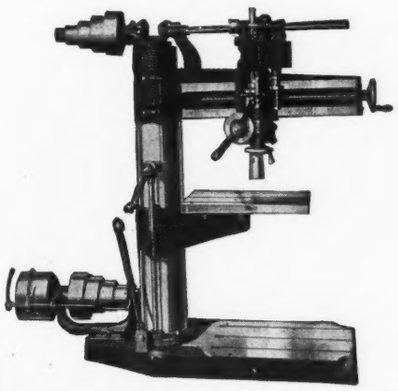
Easily controlled, quickly positioned, speedy and accurate, the Morris Radial is capable of widely diversified operations. The facility with which its tools are changed broadens the scope of the machine, and does away with expensive rehandling of parts.



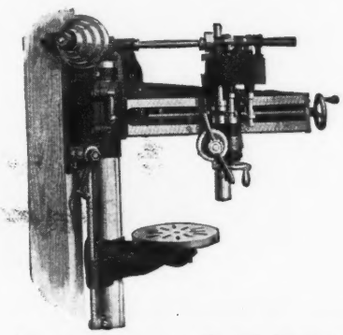
Made in sizes 2, 2½, 3, 3½, 4 and 4½ foot arm, with cone, speed box or motor drive, as well as motor on arm.

Interested? Write us.

The Morris Machine Tool Company
CINCINNATI OHIO, U. S. A.
Represented by The Niles-Bement-Pond Co., 111 Broadway, New York.



No. 101 Radial Drill furnished with 2½ and 3½ ft. arms.



No. 51 Wall Type Radial Drill furnished with 2½ and 3½ ft. arms.

Money Making Machinery

The design of Canedy-Otto Drills has called forth more approval from manufacturers using them than is usual. These strong and rugged machines have deserved this praise—earned it. They accomplish drilling with a facility and speed in handling the work which means important money in the course of a year. Look into the C-O line because it is not high-priced.

Descriptive literature will be forwarded upon request

Canedy-Otto Manufacturing Co.

Main Offices and Factory: Chicago Heights, Illinois

NEW YORK BRANCH
407 Broome Street,
New York City

Complete Stock carried at branches

SAN FRANCISCO BRANCH
955 Folsom Street,
San Francisco, Cal.

The GRANT Rotary Vibrating Riveter

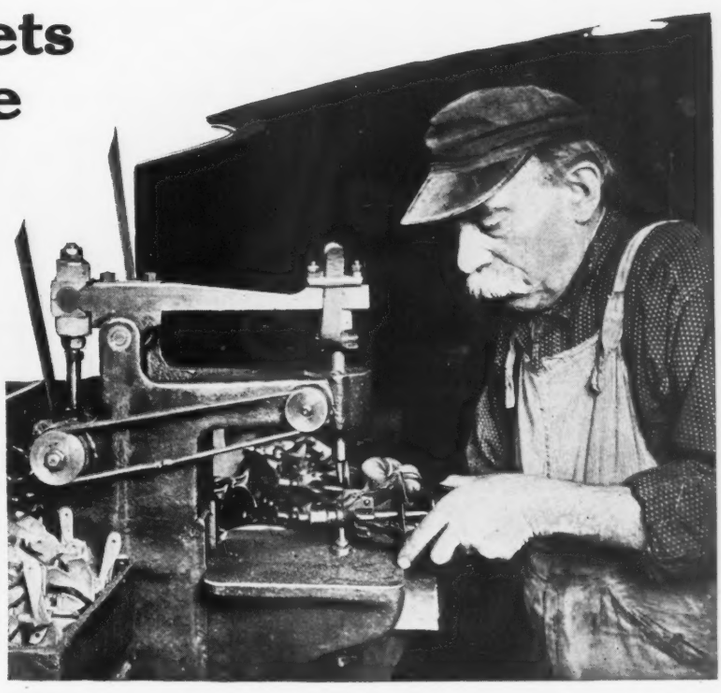
Sets These Rivets in Quick Time

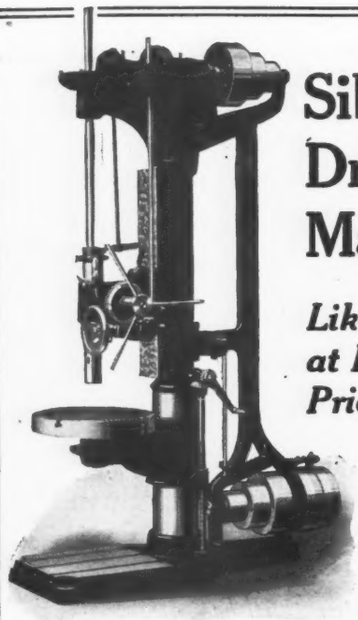
Riveting blades on boiler tube scrapers was such a difficult operation that it blocked production on these parts. As the blades are small and awkwardly shaped hand riveting seemed the only way until the Newark Brush & Scraper Company, Newark, New Jersey, tried out a Grant Rotary Vibrating Riveter. Production doubled, the work was more uniformly accurate and well finished—another manufacturing problem was profitably solved.

Grant Rotary Vibrating Riveters and Grant Rivet Spinners cover the field. Let us show you.

THE GRANT MANUFACTURING & MACHINE COMPANY

N. W. STATION, BRIDGEPORT, CONN.





Sibley Drilling Machines

Likable Drills at Likable Prices

The model shown is the Sibley 28" Sliding Head Heavy Duty Drill. Sibley Machines are made in 16" Sensitive to 30" Heavy Duty Models, Stationary or Sliding Heads.

Sibley achieves extraordinary convenience at a surprisingly low price. Any Sibley Drill can be started, stopped and feeds changed by the operator without moving from his position in front of the press.

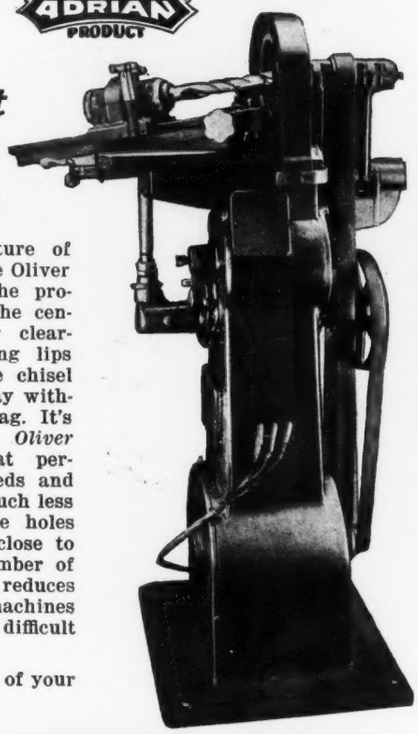
Six speeds and four feeds provide a wide range that meets every drilling requirement.

Write for prices and description.

SIBLEY MACHINE COMPANY
8 TUTT STREET, SOUTH BEND, IND., U. S. A.

AN OLIVER OF ADRIAN PRODUCT

It's the Point that Increases the Profit



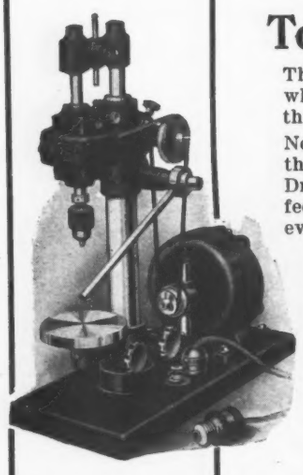
The exclusive feature of drills ground on the Oliver Drill pointer is the pronounced *hook* at the center, giving proper clearance to the cutting lips and permitting the chisel point to cut its way without the slightest drag. It's this *point* on *Oliver* ground drills that permits maximum feeds and speeds; requires much less power; gives more holes per grind; drills close to size; increases number of grinds per drill; reduces wear on drilling machines and solves many difficult drilling problems.

Let us grind a few of your drills for proof.

OLIVER INSTRUMENT COMPANY
1410 East Maumee St. ADRIAN, MICH., U. S. A.
New York Branch, 139 Lafayette St. Tel. Canal 3982.
C. D. Proctor, District Sales Representative

Drills holes .010" in diameter through steel without breaking the drill.

Handles anything up to 3/16". Speeds to 8000 R.P.M., motor and belt drive.



Touch-sensitive!

There's a fern-like plant which closes its leaves at the slightest touch.

Not a bit more sensitive than the A. M. Sensitive Drilling Machine! The feed lever is almost alive; every tremor of the drill is unfailingly transmitted to the hand of the operator. He knows instantly when the feed is dangerously heavy, and eases up.

The result is a new low record in drill breakage and a high record in production.

Every feature has a reason — catalog tells the whole story.

ADOLPH MUEHLMATT
Lion Building, Cincinnati, O.

Foot Lever Feed can be applied to any of our

SINGLE SPINDLE SENSITIVE DRILLING MACHINES

½" or ¾" Capacity, Plain Bearings, Ball Bearings. Send for circular.

FRANCIS REED CO.
43 Hammond St., Worcester, Mass.

"HOLE HOG"

Holes in line—and close together if desired.
DRILLS, REAMS, BORES

MOLINE TOOL COMPANY, Moline, Ill.

Make your drilling profitable with

HŒFER DRILLERS

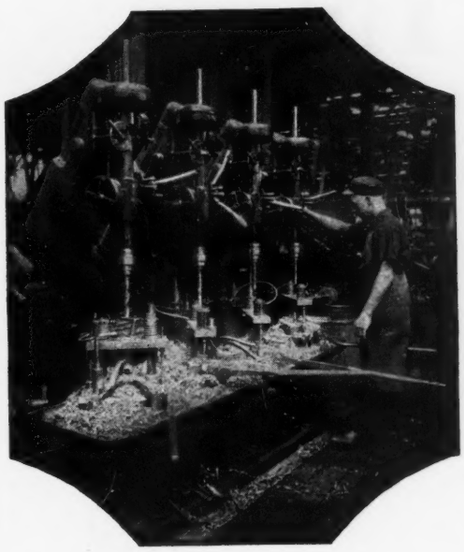
Take advantage of the "minute-saving" features of Hoefer Drillers and Auxiliary Heads.

HOEFER MFG. CO., Freeport, Ill.

"They are as durable as any machine in our shop"

—He was speaking of his

Self-Oiled, All-Geared Gang Drills



The mechanical superintendent of a leading automobile manufacturer in Detroit says: "Our reason for picking Self-Oiled, All-Geared Drills and Tappers was *low upkeep cost.* These machines are also easy to operate, reliable, accurate, quick, strong and economical. They save labor, time and power and they suit our work very fine, furthermore they are as durable as any machine in our shop."

Average Yearly Cost of Repairs

Our records show an average of less than $2.00 per machine for all All-Geared, Self-Oiled Drillers. An exceptional record when you consider the multiplied productive capacity.

SHALL WE SEND NEW CATALOG "M"?

SELF OILED DRILLS ALL GEARED

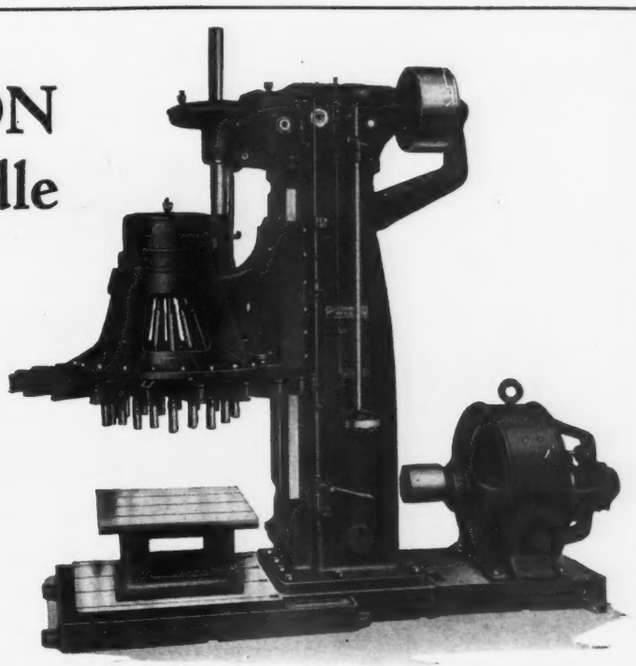
BARNES DRILL COMPANY (Inc. 1907)

814 Chestnut St., Rockford, Ill., U. S. A.

AGENTS FOR GREAT BRITAIN: Burton, Griffiths & Co., Ltd., London, E. C. FRANCE: R. S. Stokvis & Fils, Paris. JAPAN: Roku Roku Shoten, Tokyo. NEW SOUTH WALES: R. I. Scrutton & Co., Sydney. BELGIUM: G. & F. Limbourg Freres, Brussels. SPAIN: Joan Llopart, Barcelona.

HARRINGTON Multiple Spindle Drills

You'll find that there's a Harrington for every drilling job you have. You'll find, too, that every Harrington is a high grade piece of machinery.



Makers of Fine Machine Tools and Chain Hoists

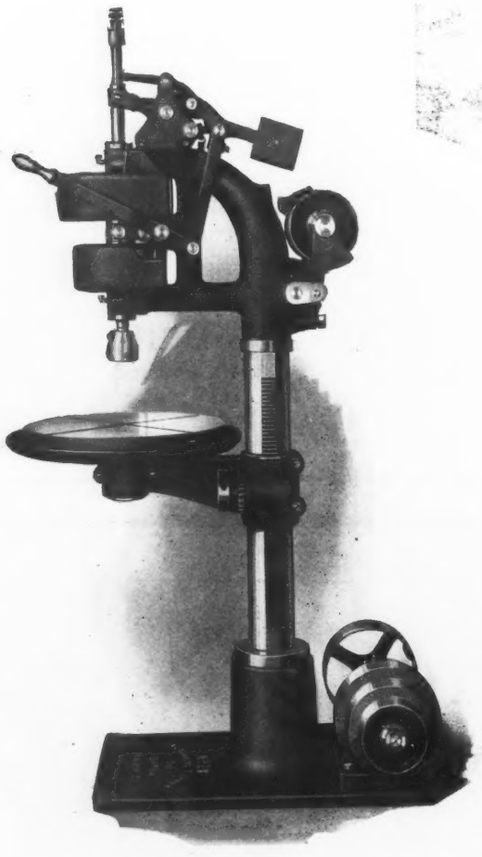
THE HARRINGTON COMPANY

PHILADELPHIA

GARVIN

AUTOMATIC TAPPING MACHINES

Now Equipped with Timken Roller Bearings



Will Speed Up Your Tapping Department

Put the Production up to the Tap

To meet the demand for greater speed in tapping with the use of High Speed Steel Taps, we have made our machines so that they can be run at High Speed. Note—Belt Guards—Timken Roller Bearings—Lubrication.

Send for Circular No. 306

THE GARVIN MACHINE COMPANY

Spring and Varick Sts., New York

Fourteen Years of Besly Tapping!

And you can bet it didn't take the P. B. Yates Machine Company of Beloit, Wisconsin, more than the first few months of those fourteen years to decide to keep Besly Taps permanently on their pay roll!

Besly Taps have tapped innumerable holes for a multitude of purposes in this plant.

This photograph was taken while a 9/16″ V-thread tap was finish tapping holes in a .50 carbon steel cutter head for a Yates Surfacer.

The 20 holes are first drilled with a 15/32″ drill, then rough tapped to 17/32″, and finished tapped with the 9/16″ 12-thread tap. The two tapping operations are necessary because the stock is too tough for nice threading with one tapping. (It is quite important to have a clean thread, as surface knives require frequent changing.)

By using them fourteen years in a row, this company recommends Besly Taps. Can you ask for a better recommendation?

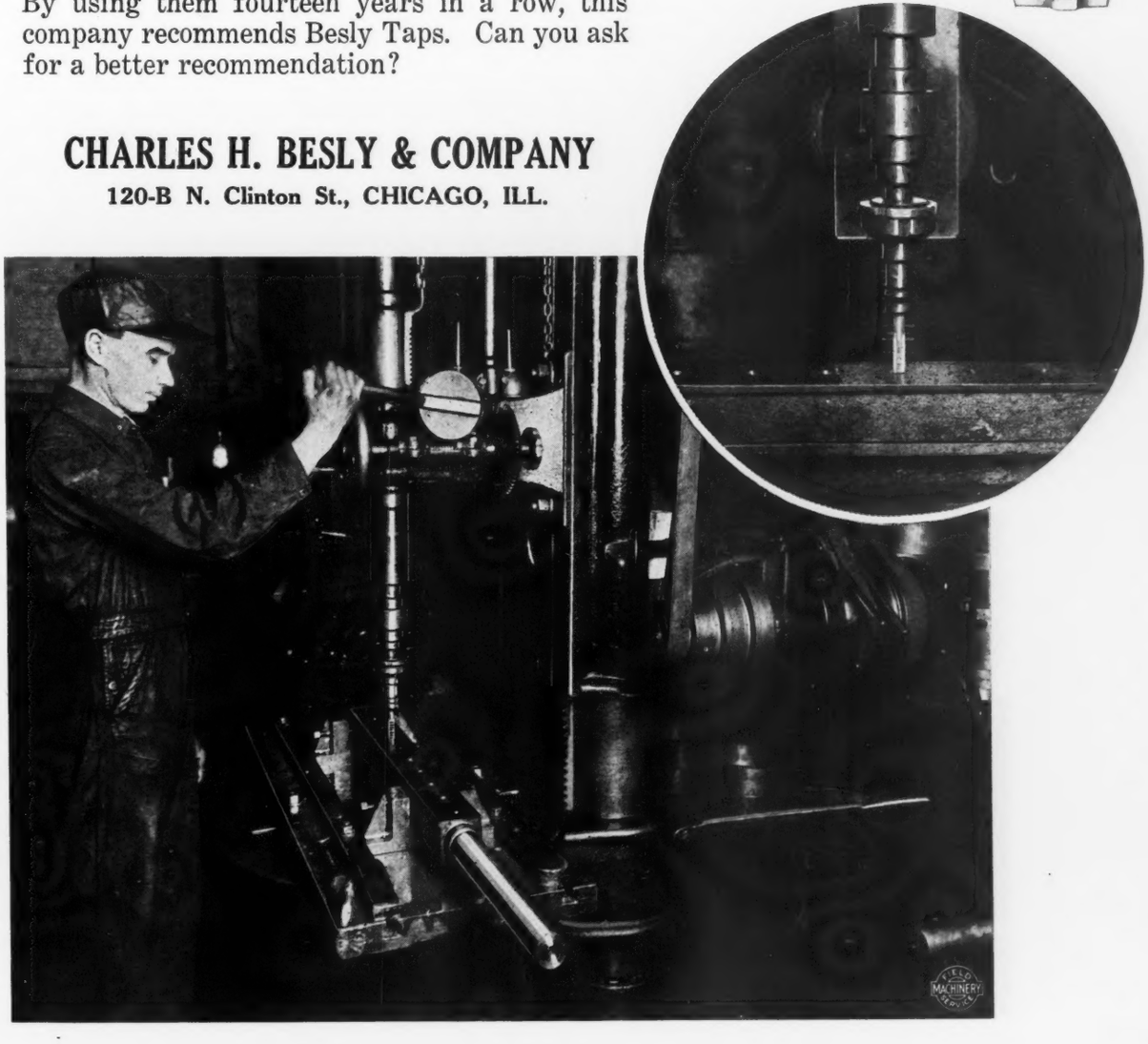
Try Besly Taps

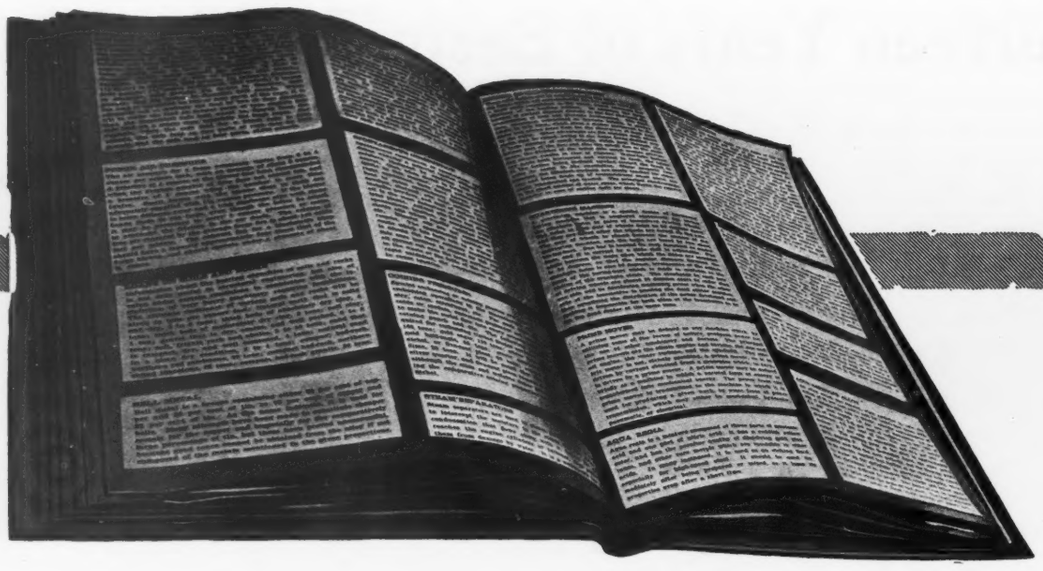
Send for the catalog

BESLY
CHICAGO

CHARLES H. BESLY & COMPANY

120-B N. Clinton St., CHICAGO, ILL.





Fair Questions—*Can you Answer them?*

***What Is:*—Tin Foil—Selective Assembly—German Silver—Weight of Air—Atmospheric Pressure—Blanched Copper—Corona Loss—Bismuth Bronze—Electro-etching—Machine Steel—Ajax Metal—Power of Windmills—Electrolysis—Speculum—Chromatic Speed Range—Lead Burning—Force-feed Lubrication—Buoyancy—British Thermal Unit—Cyanide Method of Coloring Steel?**

If you have a MACHINERY SCRAP-BOOK, kept up to date, you can answer these questions accurately and completely. These are only a few of many subjects covered so far in the compact articles that make up MACHINERY'S SCRAP-BOOK (see pages 948 and 949 this number). Why not start, today, to keep a SCRAP-BOOK? MACHINERY provides the SCRAP-BOOK itself, and the material.

The book is "tailor-made"; size 8½ x 12; bound in dark green crash cloth—thirty-six pages of tough brown paper and special index on white ruled paper.

Use the Coupon Below—It is There For your Convenience—Nothing More is Necessary

Send your subscription for MACHINERY for one year, or, if you are a reader now, simply send your renewal order. The SCRAP-BOOK goes to you as a matter of course. You pay the usual $3.00 for your subscription—not one cent more—and for that you receive not only the twelve copies of MACHINERY but the SCRAP-BOOK also. It makes no difference when your subscription expires—tell us now to add another year to the expiration date and start your SCRAP-BOOK at once. It is ready to go to you.

The Industrial Press, Publishers of MACHINERY,
140-148 Lafayette Street, New York City.

Send me a SCRAP-BOOK and enter or extend my subscription for MACHINERY for one year. No charge is to be made for the SCRAP-BOOK.

I will send you $3.00 for my subscription for MACHINERY when the bill comes.

*Name*_____

*Address*_____

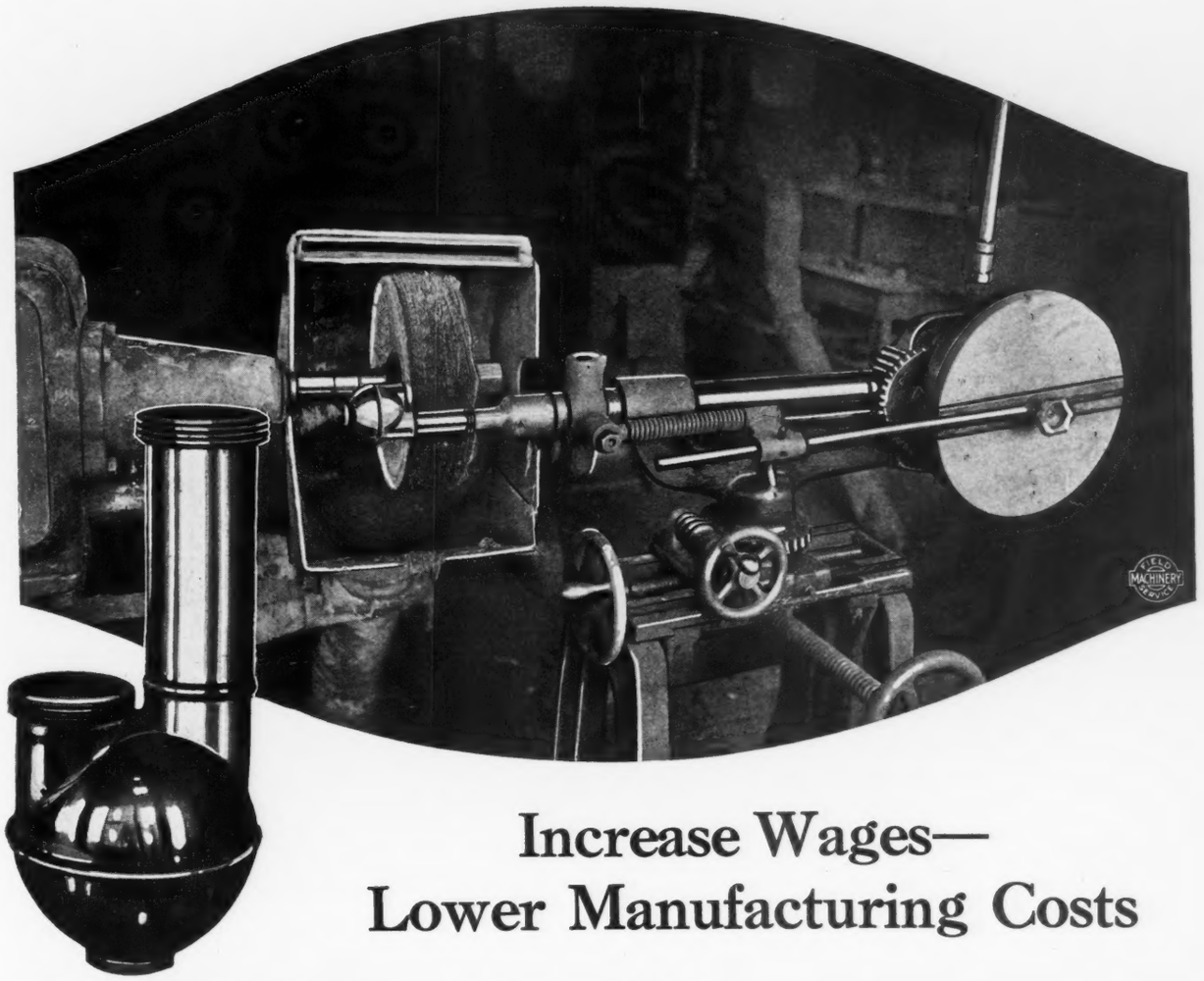
*City*_____ *State*_____

*Position*_____ *Firm*_____

Upon receipt of this order your scrap-book will be sent.

8-24

Automatic Buffing Machines



Increase Wages—
Lower Manufacturing Costs

Better production at higher wages is more profitable than poorly paid labor using old-fashioned methods. Every manufacturer knows this is a fact, but it is not often so clearly demonstrated as by the Automatic Buffing Machine operation discussed here.

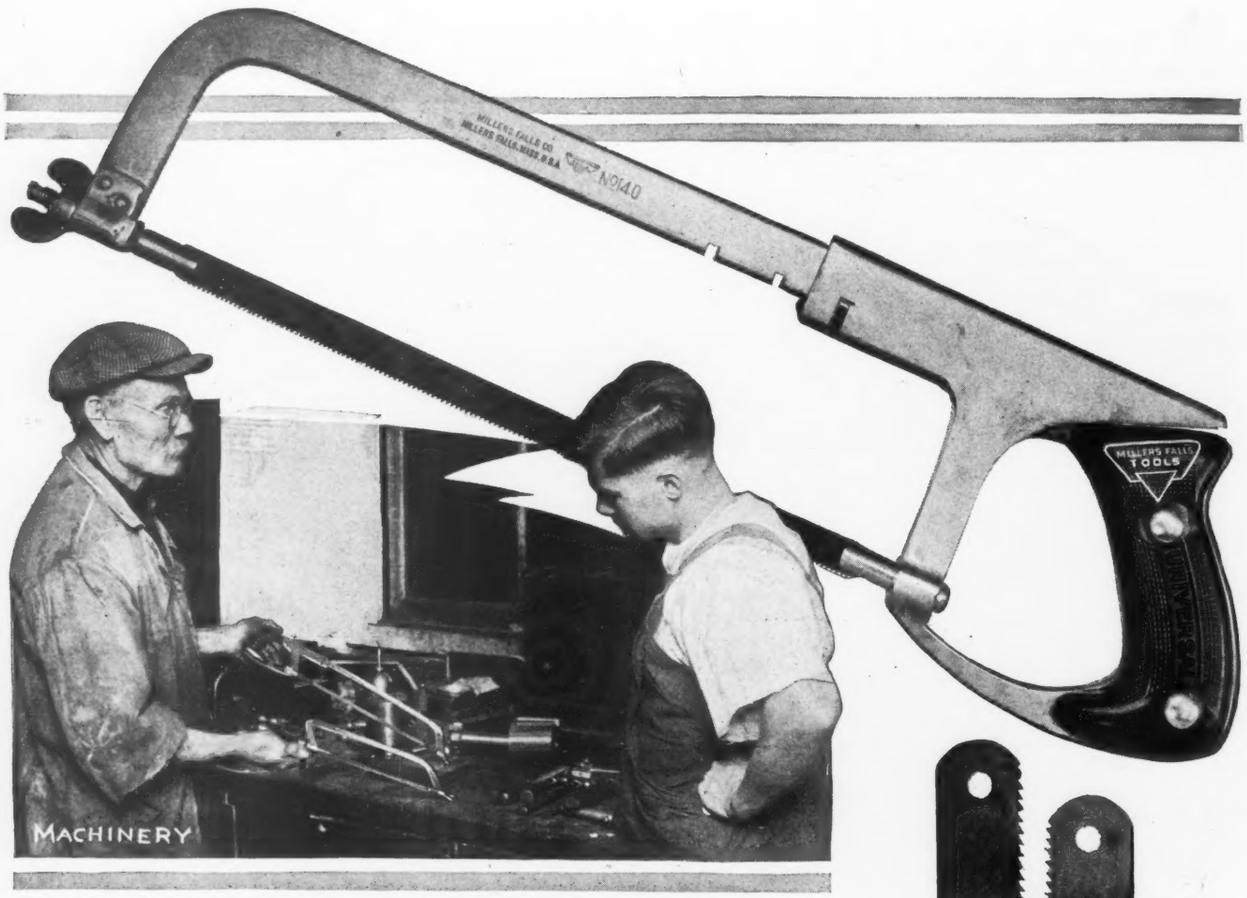
The photograph shows part of an installation of twelve machines in the plant of a manufacturer of plumber's supplies. Though the operator, polishing ball traps at the rate of 1000 per nine hours, gets 72 cents an hour it costs only $1.75 per hundred to finish these parts (including some hand finishing) as against $2.25 per hundred when labor was only 45 cents per hour. Manufacturer and operator both make more on the job, machine buffed parts are more uniform and the operator works under less strain. The efficient application of modern machinery is the one way in which industry can keep up with rising wages and keen competition.

Where operations include buffing or polishing in quantity Automatic Buffing Machines are cutting costs.

Let us tell you

THE AUTOMATIC BUFFING MACHINE COMPANY

Chicago and Perry Streets **BUFFALO, NEW YORK**



Pick a Good Frame— the Blade Deserves it

"With experience, son, will come the ability to choose your tools correctly, to recognize the combinations which will do the most for you.

"You know how the Millers Falls Hacksaws are made; know their quality, their uniformity—now pick out a frame that will give the blade an opportunity to make the most of the quality that is built into it.

"Millers Falls frames are adapted—for every requirement. The old frame in my right hand I used a good many years, but now I find this new type Millers Falls frame has a more comfortable grip, is adjustable for various blade lengths and holds the blade steadier.

"Here's something to remember about any frame. After it has been in service a while the back may become bent from over-tightening the blade, so when you tighten up a new blade it is necessary to pull the anchor block so far that the end of the blade strikes the frame and you don't get enough tension. Watch for this—straighten out the frame when it happens—you'll be amply repaid for your trouble in better work and longer lived blades."

Millers Falls Hacksaws—Millers Falls Frames—the combination is unbeatable—use them for better work. Usable hacksaw logic every month—September's on the way.

MILLERS FALLS COMPANY

MILLERS FALLS, MASS., U. S. A.

Hack Saw Plant

Formerly WEST HAVEN MFG. COMPANY
West Haven, Conn.

PEERLESS
MACHINE CO.
RACINE WIS. U.S.A.
Peerless High Speed Metal Saw 6" x 6".
Peerless High Speed Gap Saw, nominal capacity 13" x 16", excess capacity 16"x 37"
13 X 16
GAP SAW
PEERLESS
MACHINE CO.
RACINE WIS. U.S.A.
Peerless High Speed Metal Saw, Two sizes, 9"x 9" 13" x 16".
Peerless Universal Shaping Saw, 6⅝" x 6⅝".
Peerless Universal Shaping Saw, 13" x 13".
Peerless
HIGH SPEED

Save Two Pounds of Steel on a 6-inch Gear Blank

How? By wasting less stock in cutting it up. Take a 1/32″ cut instead of ⅛″ in sawing up 6″ steel forgings for gear blanks and you save about two pounds of steel. With steel at 10 or 12 cents a pound that's worth while.

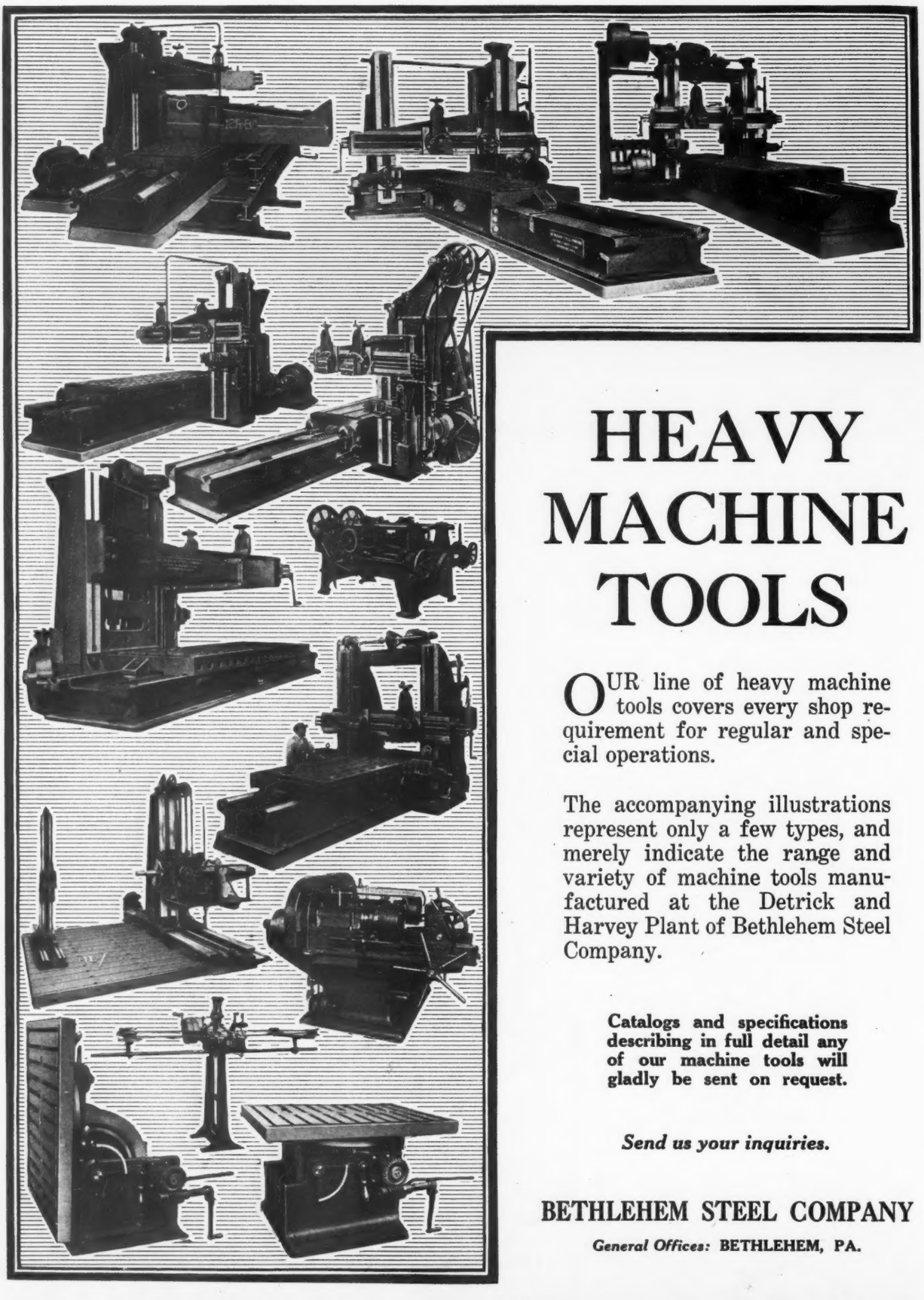
Peerless Universal Shaping Saws take such accurate cuts that they do away with most of the second operation work. They saw gear blanks so parallel that two tools can be used simultaneously after the work has been placed on an arbor. They produce duplicate parts within their range at greater speed and lower cost than can be obtained by any other method—we are ready to prove this statement.

Five saws, to meet all cold saw needs, are shown here; complete description in the Peerless Booklet—"A New Departure in the Sawing of Metals." Let us send it.

Peerless Machine Co.

1352 Clark St., Racine, Wis.

N. Y. Office: 165 Chambers St.



HEAVY MACHINE TOOLS

OUR line of heavy machine tools covers every shop requirement for regular and special operations.

The accompanying illustrations represent only a few types, and merely indicate the range and variety of machine tools manufactured at the Detrick and Harvey Plant of Bethlehem Steel Company.

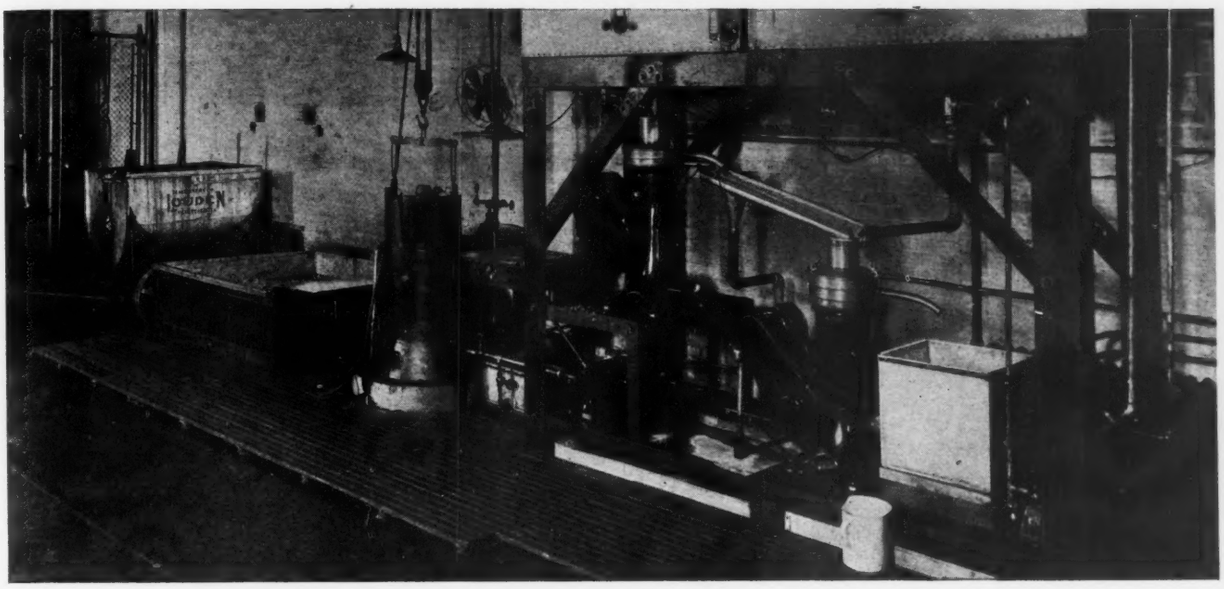
Catalogs and specifications describing in full detail any of our machine tools will gladly be sent on request.

Send us your inquiries.

BETHLEHEM STEEL COMPANY

General Offices: **BETHLEHEM, PA.**

BETHLEHEM



Oil reclaiming department of Hoover Suction Sweeper Co., North Canton, Ohio, showing two De Laval Centrifugals which enable the saving of 2000 gallons of oil a month.

How Hoover Suction Sweeper Co. saves 2000 gallons of cutting oil a month

As a result of the installation shown above the Hoover Suction Sweeper Company has practically eliminated waste of cutting oil in its plant at North Canton, Ohio. Moreover, the oil in the system is constantly kept cleaner than was formerly possible, so that all the economies of using clean oil are effected along with a great reduction in the oil bill.

The two De Laval Centrifugals make it possible to use a chip extractor of the type which applies live steam to the chips. This heat frees them of that portion of the oil which is invariably found on chips coming from a "cold" extractor.

Fine particles of metal and other dirt are centrifuged out of the recovered oil by the De Laval Multiple Clarifier. Water which gets into the oil as a result of the steaming process is next centrifuged out by the De Laval Oil Purifier. After this last treatment the oil is for its purpose equal to new, and it is pumped into the storage tank.

Besides greatly reducing the consumption of cutting oil, it has been found that De Laval cutting oil installations make it possible to increase the cutting speed of machines; improve the work; enable cutting tools to give longer service, and practically eliminate cases of septic poisoning among workmen. Bulletin No. 101 tells why. Write for it.

The De Laval Separator Company

165 Broadway, New York 29 East Madison St., Chicago

DE LAVAL PACIFIC COMPANY

San Francisco

Sooner or later you will use a

De Laval

Gentlemen: Please forward a copy of De Laval Bulletin No. 101, which tells how we can save cutting oil and increase production.

Name .....

M

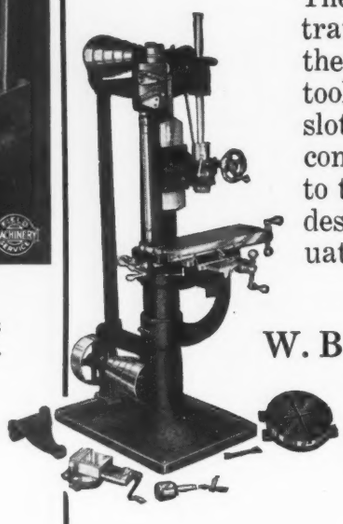
Company .....

Address .....

Tell us your requirements; we'll be glad to advise.

Versatility makes Knight Millers Profitable

It will be difficult for you to find, within its range, anything that a Knight Miller can't do.



The photograph affords a good illustration, more forcible than words, of the handiness of the Knight Miller. The toolmaker is end milling a 45 degree slot in a boring bar. The procedure consists of simply clamping the work to the table and tilting the latter to the desired angle, as indicated on the graduated segment.

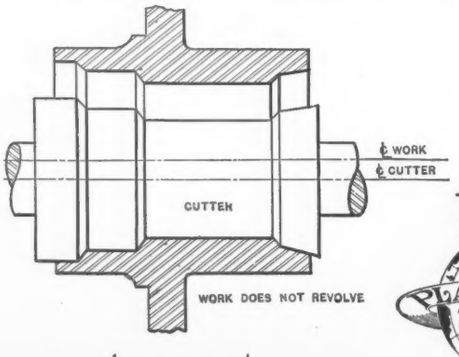
W. B. KNIGHT MACHINERY CO.

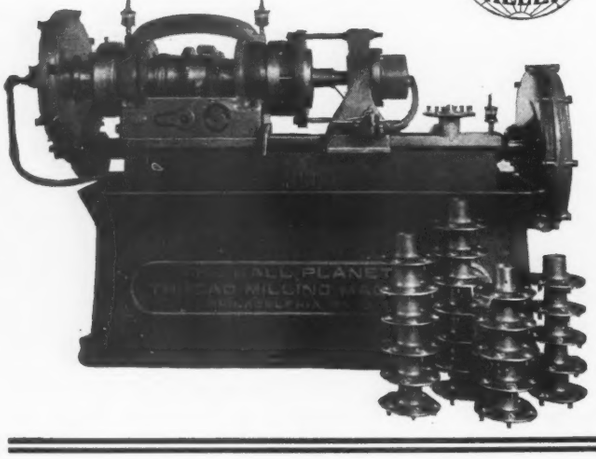
3920 W. Pine St. St. Louis, Mo., U. S. A.

FOREIGN AGENTS—The Coats Machine Tool Co., Ltd., London, Eng.; Yamatake Company, Tokyo, Japan; Allied Machinery Co. of America, France, Spain, Portugal, Italy, Switzerland Belgium.

CIRCULAR FORM MILLING—

A New Name for a New Operation





The Hall Planetary Thread Milling Machine makes it possible to apply the form milling principle to internal cylindrical surfaces. The operation is very simple and practically automatic; chuck the work and touch the starting lever. The cutter feeds to depth, revolves around the circumference and returns to starting position.

The drawing of an auto hub will give you some idea of production possibilities; 3½" diameter by 4¼" long, this piece is "circular form milled" in one minute, floor to floor. Think that over.

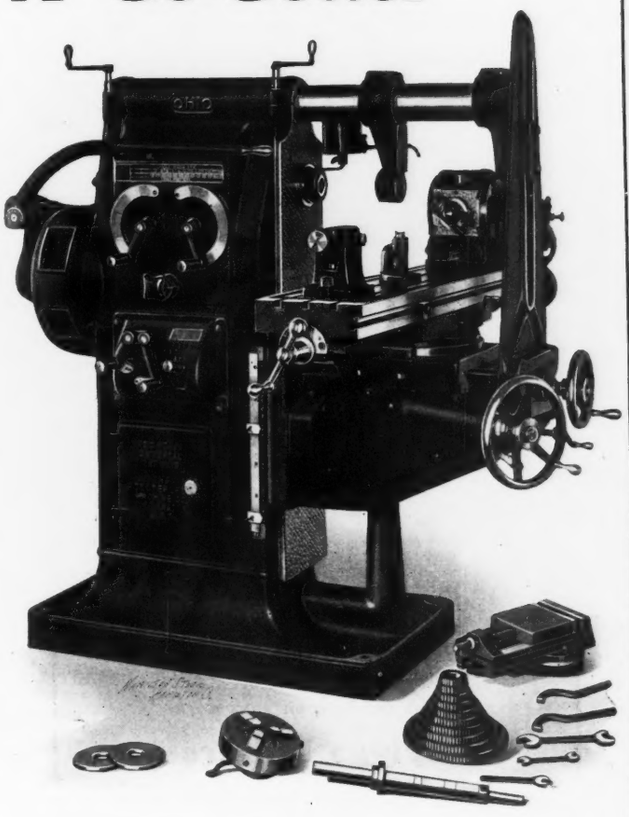
Let us give you a production estimate on your work

The Hall Planetary Thread Milling Machine Co., Inc.

Bridesburg, Philadelphia, Pa.

AGENTS: Detroit, J. C. Austerberry. Cleveland, The Cleveland Duplex Machy. Co., Inc. Rochester, N. Y., Ogden R. Adams Co., Inc. New York City, Triplex Machine Tool Corp., 50 Church St. Chicago, Neff, Kohlbush & Bissell.

A "Go-Getter"



Ohio Constant Speed Miller

This machine has been so simplified by the elimination of unnecessary parts and complicated mechanisms that it is practically trouble-proof—yet it has every essential required for up-to-date milling. "Ohio" lubrication is automatic; fed by gravity, only fresh oil reaches the spindle and main bearings. Sixteen speeds are obtainable with three shafts, the spindle, the pulley shaft and one intermediate shaft. No stopping machine for speed changes.

Ohio Millers are built in six sizes—both plain and universal types.

Want a copy of the catalog?

MILLERS OHIO GRINDERS

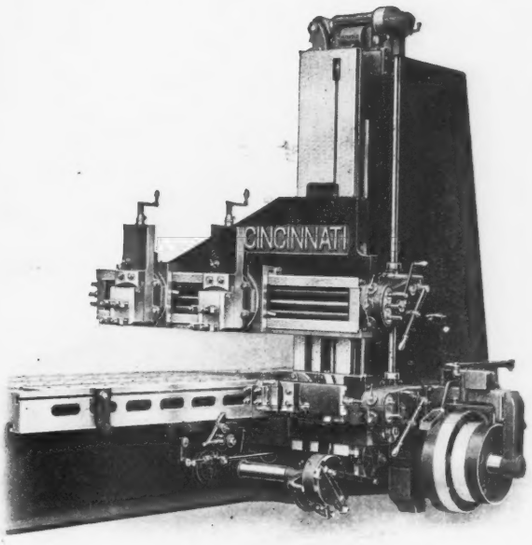
"Tools In Which Every Ounce Works"

The Oesterlein Machine Co.

CINCINNATI OHIO, U. S. A.

When in Doubt as to the Size of Machine, Buy an

OPENSIDE PLANER



CINCINNATI OPENSIDES

meet all the requirements and more. They increase production and insure accuracy.

Tu-Speed Drive—Rapid Power Traverse—Forced Lubrication, Herringbone Gears, Box Table and Column.

Planers Boring Mills

The Cincinnati Planer Co.

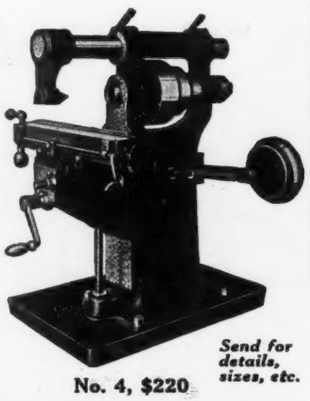
Cincinnati, Ohio

BURKE Bench Millers

For Low Cost and Rapid Production

Careful construction, accuracy in manufacture and operating efficiency insure low production costs that, combined with the moderate purchase price, make a Burke a "good buy."

Made in five sizes (prices from $100 to $220) hand or power feed. Special attachments such as Index Centers, Vertical Milling Attachments, Slotting Attachments give these light weight milling machines an extremely wide range on small work.



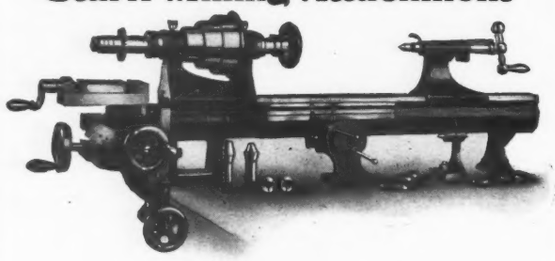
No. 3, $155

The Burke Machine Tool Company
516 Sandusky Street CONNEAUT, OHIO, U. S. A.

No. 4, $220

Send for details, sizes, etc.

Stark Milling Attachment



A FINE PRECISION TOOL
RUGGED ENOUGH TO DO REAL WORK

STARK TOOL CO., Waltham, Mass.
Established 1862. Originators of the American Bench Lathes

Fast Producers

Briggs Millers are fast, accurate, economical producers. Rugged arch support for the arbor assures accuracy, no matter how heavy the cut, and permits coarse feeds without chatter. Can be operated to advantage in battery. Ask for production reports and details of these simple, powerful machines.

Let us estimate on your work.

Briggs Millers

GOOLEY & EDLUND, Inc., Cortland, N.Y.

THREAD MILLERS

Let us know what your threading and form milling problems are so we can give you time estimates. Thread milling on a rigid machine like ours produces superior finish, accurate sizes, and perfect lead in a rapid operation.

We have shown large savings in general threading work, oil well work, taps, dies and flanges. We mill straight or tapered, inside, or outside, right, or left hand threads on the same machine.

SMALLEY-GENERAL COMPANY
BAY CITY, MICH.

U. S. HAND MILLERS
For all classes of light milling
U. S. SENSITIVE DRILLERS
For all classes of light drilling
SEND FOR CIRCULARS AND PRICES
United States Machine Tool Co. CINCINNATI, OHIO

LIBERTY PLANERS

Past performance proves you can't go wrong on a Liberty. Open Side Models, from 24" to 84". Double Housing Standard Types, from 22" to 72".

Send for Description

LIBERTY MACHINE TOOL CO. HAMILTON OHIO, U.S.A.

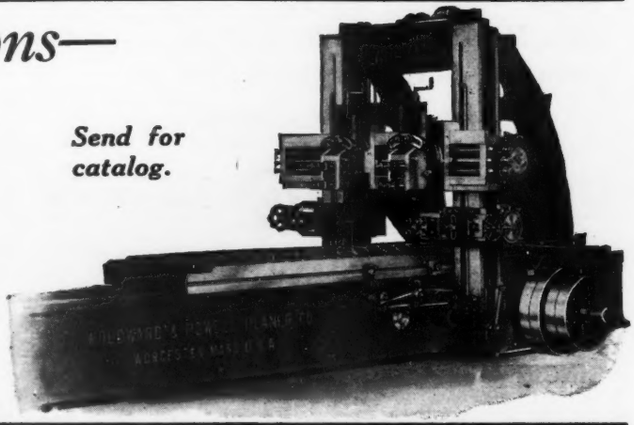
Necessary Qualifications—

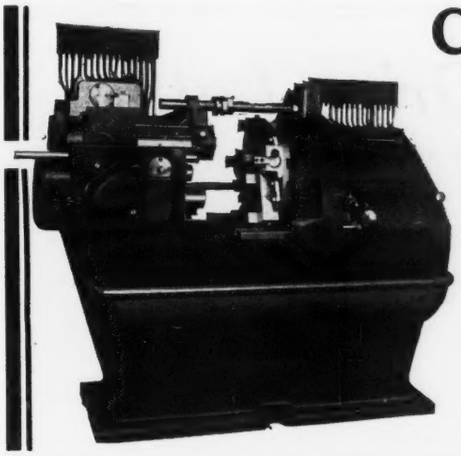
Power, accuracy, convenience—you need them in all machines, can't get on without them in a planer. Therefore—Woodward & Powell Planers for profitable planing. They get good results, are durable and—as one manufacturer writes—are completely satisfactory in every respect.

Belt or motor drive; standard, medium, heavy duty types.

Woodward & Powell Planer Co.
Worcester, Mass., U. S. A.

Send for catalog.





Cut Time—Get Big Production

This machine fills a long felt want—a multiple chucking machine that combines big production with high accuracy on duplicate parts. The

Goss & DE Leeuw Chucking Machine

will give exacting and accurate service in turning, boring, threading and reaming duplicate parts up to 6 inches in diameter and to 6¾ inches in length. It is of the multiple spindle type; work is held in a turret; two-jaw chucks are generally used, but three and four-jaw universal chucks can be easily accommodated.

We'll be glad to send full information.

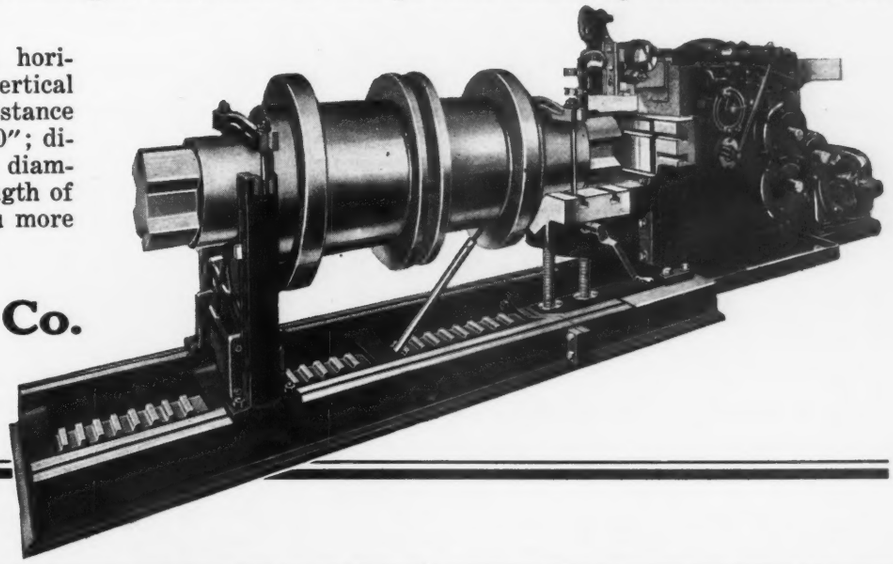
The Goss & DE Leeuw Machine Co., New Britain, Conn.

The Morton Roll Wobble Planer

REAL MORTON EFFICIENCY FOR A DIFFICULT CLASS OF WORK

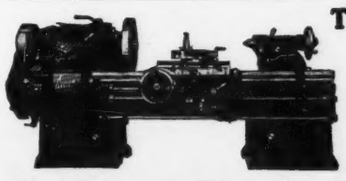
Note the long, heavy base and the ample, easily adjustable supports—these make it possible to handle the longest, most unwieldy rolls without difficulty. Accurate, rigid construction, correct alignment and special operating conveniences give further advantages that add to the profits made by these machines.

Specifications: stroke 32″; horizontal feed in head 12″; vertical feed in head 6″; greatest distance between ram and V table 30″; diameter of largest roll 56″; diameter of largest neck 28″; length of bed 22′, 7″. Let us tell you more about this machine.



Morton Mfg. Co.

Muskegon Heights,
Michigan, U. S. A.



The Greaves-Klusman Lathe is adapted to handle a wide range of work and is equipped to insure convenience, precision and speed. Exclusive structural features eliminate all danger of twisting and bending the bed, of buckling or impairing alignments under the highest speeds and heaviest cuts. Made in 14, 16, 18, 24 and 30 inch sizes. Details sent on request.

The Greaves-Klusman Tool Co., CINCINNATI, OHIO, U. S. A.

CHAMPION LATHES

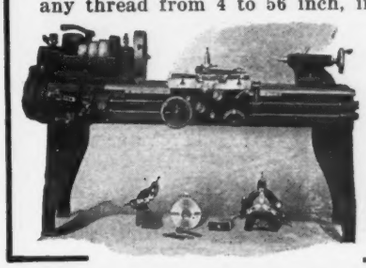
are substantial, strong, durable; handle a wide range of work; are accurate producers and cost reducers. Let us tell you all about them.

CHAMPION TOOL WORKS

4955 SPRING GROVE AVE., CINCINNATI, OHIO

You Can't Beat It!—

For manufacturing or experimental work you can't beat the Rockford "Economy" Engine Lathe. It handles a large variety of work *economically* and accurately. These aren't mere claims, but facts backed up by reputable users. Chasing dial permits cutting any thread from 4 to 56 inch, including 11½.



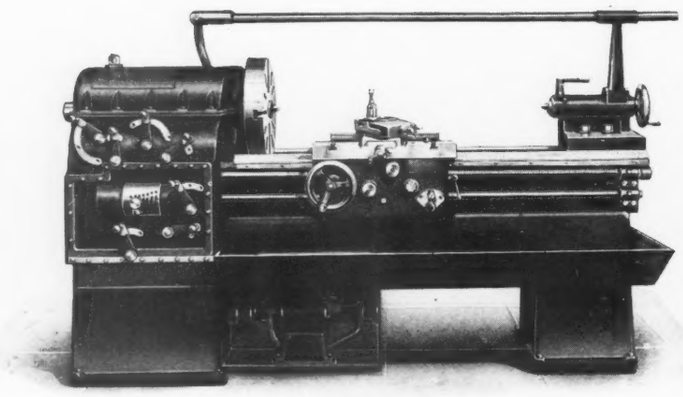
Let us tell you all the "economical" advantages of the "Economy" Lathe

ROCKFORD LATHE & DRILL CO.

Rockford, Ill., U. S. A.

The WALCOTT *Low Drive Lathe*

A Practical General Purpose Tool



Designed for fine tool-room, repair and heavy duty work. Serving in any capacity the Walcott Low Drive Lathe is fast, accurate and efficient. Well balanced, powerful and extremely easy to operate.

These advantages merit a careful investigation before you purchase your lathe equipment.

Furnished with motor drive at a small additional cost.

Write for complete information on this better Lathe

WALCOTT LATHE COMPANY

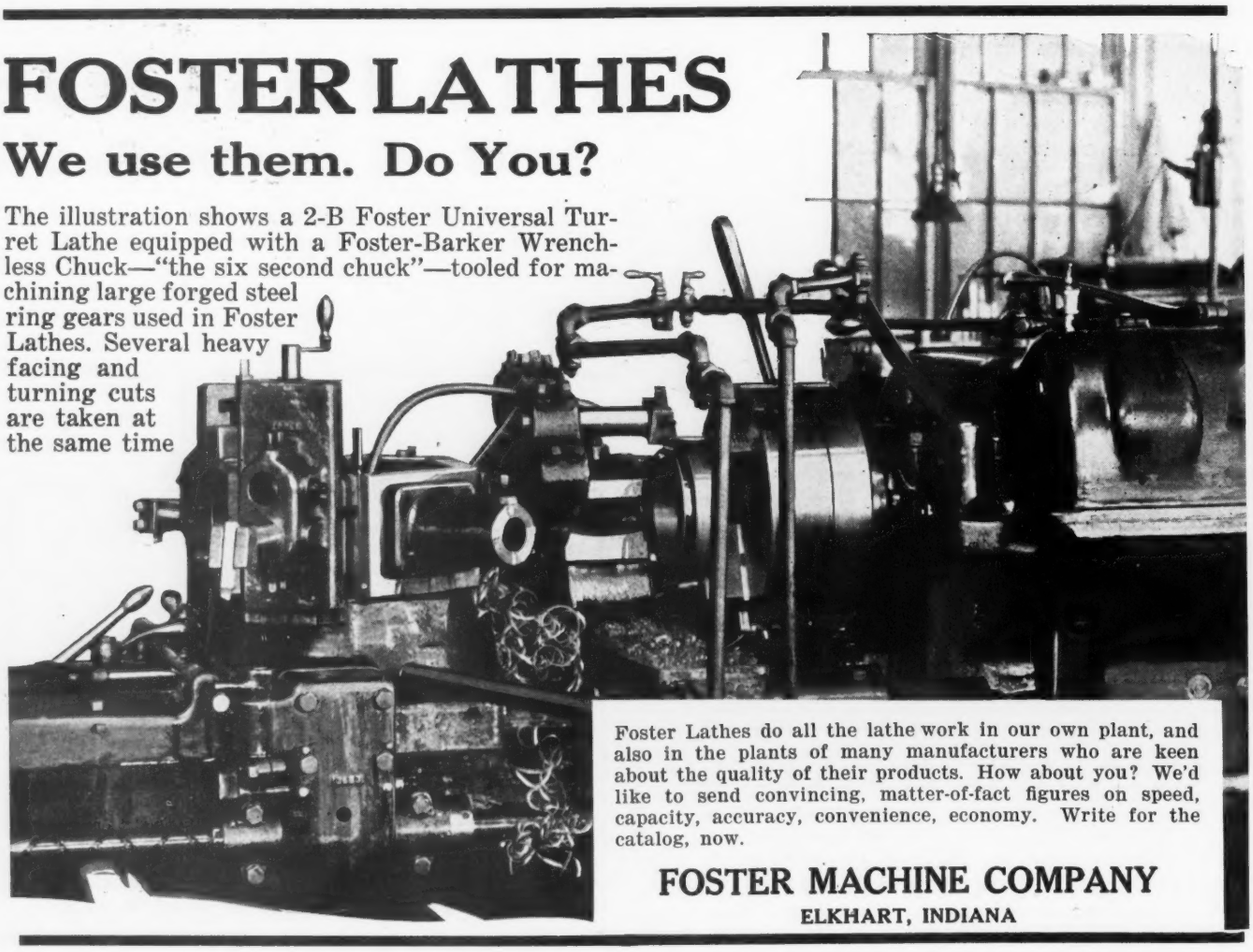
JACKSON, MICHIGAN

The WALCOTT Low Drive LATHE

FOSTER LATHES

We use them. Do You?

The illustration shows a 2-B Foster Universal Turret Lathe equipped with a Foster-Barker Wrenchless Chuck—"the six second chuck"—tooled for machining large forged steel ring gears used in Foster Lathes. Several heavy facing and turning cuts are taken at the same time

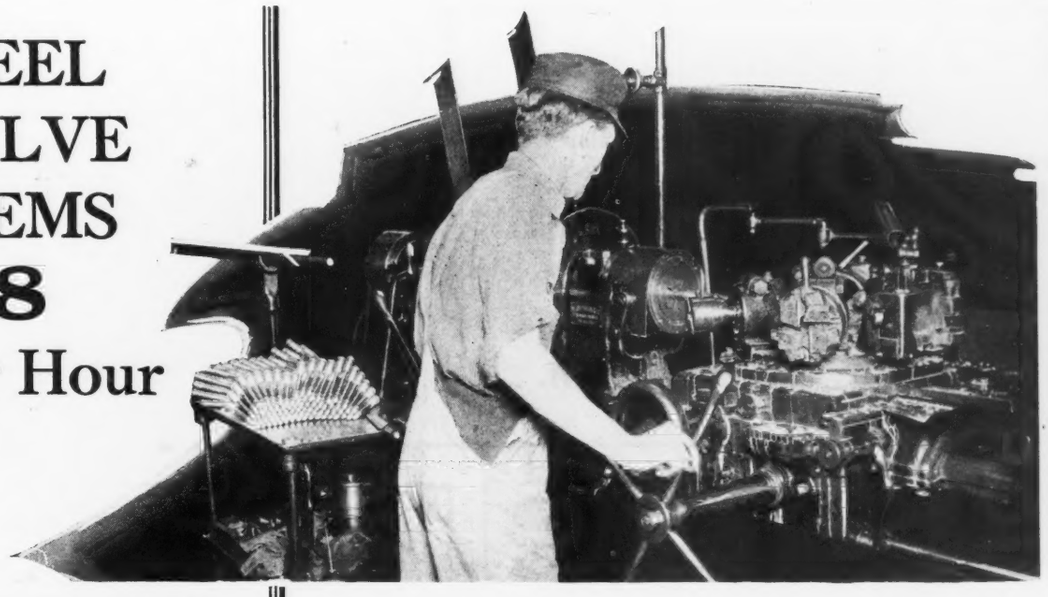


Foster Lathes do all the lathe work in our own plant, and also in the plants of many manufacturers who are keen about the quality of their products. How about you? We'd like to send convincing, matter-of-fact figures on speed, capacity, accuracy, convenience, economy. Write for the catalog, now.

FOSTER MACHINE COMPANY

ELKHART, INDIANA

STEEL VALVE STEMS 8 Per Hour



Compare this time to similar work of your own. Profitable? You bet! Send for details.

The Acme Machine Tool Company

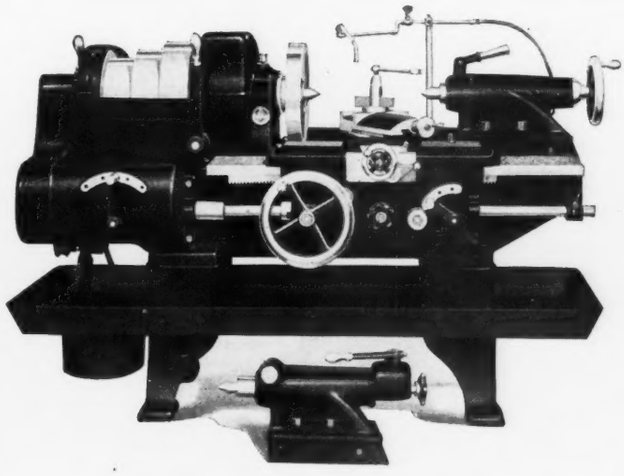
CINCINNATI OHIO, U. S. A.

Turret Lathes Screw Machines
Flat Turret Lathes

Agents in all leading cities in this country and abroad.

To keep the famous ice-making equipment of the York (Pa.) Manufacturing Company at its well-known quality level and meet its deliveries, demands machinery that will make parts as near perfect and also as quickly as possible.

A Cincinnati Acme Turret Lathe is given the job of forming and threading cold rolled steel ammonia valve stems, 1¼″ diameter; work it accomplishes at the rate of 8 stems per hour. Operations as follows: Feed stock; turn ⅝″ diameter 6⅝″ long; turn ⅞″ diameter 2⅝″ long; turn 9/16″ and ½″ diameters; cut ½″ thread; cut ⅞″ thread; neck, form head and cut off.



18″ extra heavy duty Monarch Manufacturing Lathe. Friction head, with or without back gears. 4″ driving belt. Built in 6′, 7′, 8′ bed lengths.

A New Rapid Production Lathe for Heavy Work

This new Heavy Duty "Monarch," weight 4000 lbs., is making good on heavy jobs, where increased driving power, coarse feeds, assured rigidity, and rapid convenient control are desired.

Your inquiries are solicited, tell us the nature of your work.

THE MONARCH MACHINE TOOL COMPANY

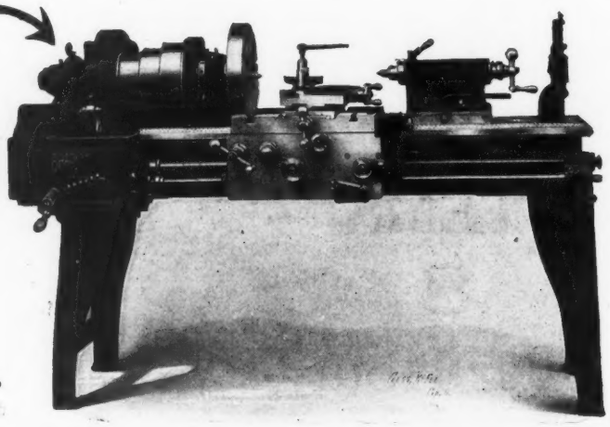
209 OAK STREET, SIDNEY, OHIO

A Good Engine Lathe

A Bradford—Engine, Precision, Turret—Lathe is foundation equipment for good machine shop production.

Well built machines, accurate and convenient; they give profitable service.

Sizes 14" to 42"; cut shows the Bradford 14" Quick Change Gear Engine Lathe.

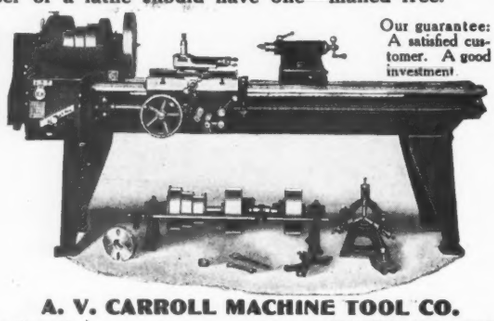


Get Details of the Entire Line

THE BRADFORD MACHINE TOOL CO.

CINCINNATI, OHIO, U. S. A.

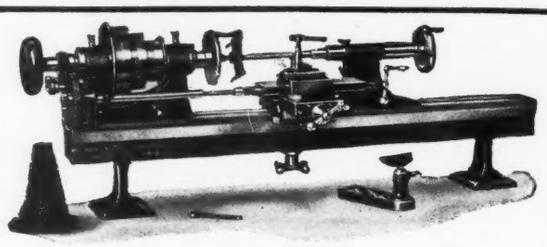
A. V. Carroll Lathes, actual swing 16½", 19" in the patented gap. Sizes 12" to 21". Send for circular and instructions showing how to save 25%—every user of a lathe should have one—mailed free.



Our guarantee: A satisfied customer. A good investment

A. V. CARROLL MACHINE TOOL CO.

Station H CINCINNATI, OHIO



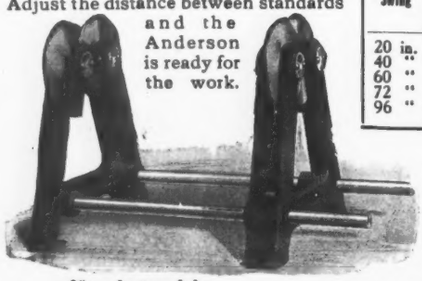
Almost a Complete Machine Shop

An Elgin Precision Bench Lathe with attachments is capable of turning, boring, drilling, milling, sawing, slotting, shaping, grinding, etc. Excels larger tools on production, is unexcelled for precision. Details on request.

ELGIN TOOL WORKS, Inc., ELGIN, ILLINOIS

For Balancing

Try Anderson Balancing Ways. The first cost is low and there's *no upkeep.* Adjust the distance between standards and the Anderson is ready for the work.



They are made in the following sizes

Swing	Greatest Distance Between Standards	Capacity in Lbs
20 in.	20 in.	1,000
40 "	30 "	2,000
60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000

Models for balancing, trueing and straightening anything up to 10,000 lbs. Disks are chilled iron, turning on ball bearings. Get prices.

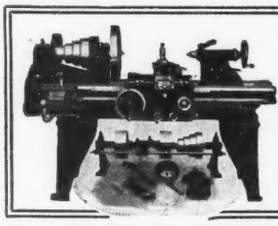
Manufactured by

ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET ROCKFORD ILLINOIS

FLATHER LATHES

HIGHEST GRADE FOR TOOL-ROOM AND MANUFACTURING PURPOSES

The Flather Company, Nashua, N.H.



SOUTH BEND LATHES

Over 30,500 satisfied users.

Made in all sizes 9" to 24" incl.

16"x6' Quick Change Gear $466

16"x6' Standard Change Gear $406

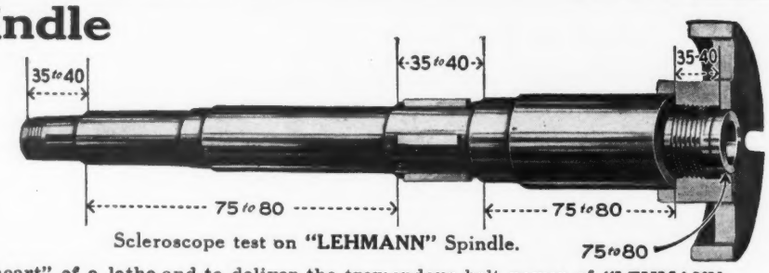
Recommended for general manufacturing, machine shops and toolrooms. Write for Catalogue 83.

South Bend Lathe Works

345 E. Madison St., South Bend Ind.

A Super Lathe Spindle

Lowers co-efficient of friction
Improves wearing qualities
Maintains alignment
Bearings practically indestructible
Drive through four integral keys
Double spindle nose (patented) gives maximum torque value, large shoulder, maximum length of fit.
Permits close fits of chuck plates and facilitates putting on and taking off.



Scleroscope test on "LEHMANN" Spindle.

It is recognized that the spindle is the "heart" of a lathe and to deliver the tremendous belt power of **"LEHMANN LATHES"** the Spindle has been brought to its present high development, with suitable means for fastening chuck plates to same to carry full value through this connection which is usually a weak point.

The same superiority of construction will be found in all other parts of the **"LEHMANN LATHE."** Our catalog gives you full details. May we send you a copy? Write today—NOW. No obligations.

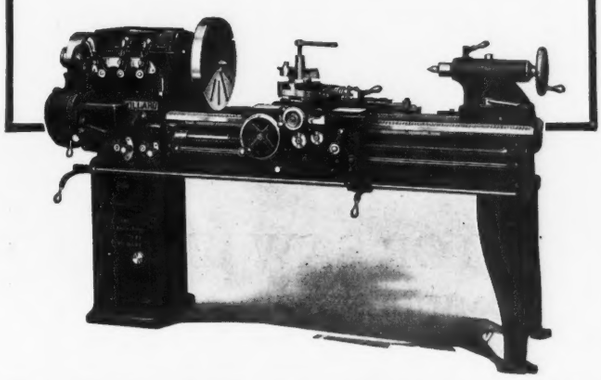
LEHMANN MACHINE COMPANY, 3571 Chouteau Ave., St. Louis, Mo.

You Can't Lose

With a Willard Precision Lathe in your shop you can take on those hurry-up production jobs without any fear as to how you'll come out on them. The Willard will handle the fast job or intricate operation in a way that always spells profit—you can't lose.

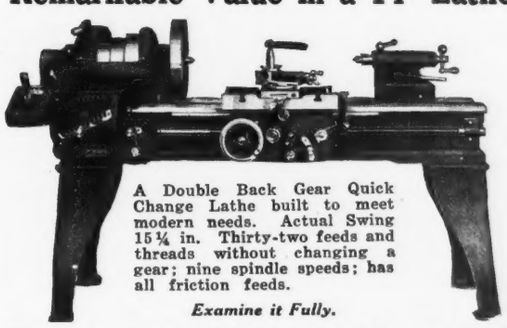
The Willard has single pulley drive; sliding gears of chrome nickel steel, oil hardened and ground. Shafts run on S.K.F. Bearings. The Willard is a real production machine.

Let us send full details.



The Willard Machine Tool Co., Cincinnati Ohio

Remarkable Value in a 14" Lathe



A Double Back Gear Quick Change Lathe built to meet modern needs. Actual Swing 15¼ in. Thirty-two feeds and threads without changing a gear; nine spindle speeds; has all friction feeds.

Examine it Fully.

The Carroll & Jamieson Machine Tool Co.
253 Davis Avenue, Batavia, Ohio

Steinle Turret Machine Co.
THE FULL SWING SIDE CARRIAGE
TURRET LATHE
STEINLE TURRET MACHINE CO.
MADISON WISCONSIN U. S. A.

Cone 4-Spindle Automatics

Are economical and accurate producers of screw machine parts up to 3½" to 7". They cut costs, increase production, boost profits. Write for particulars.

CONE AUTOMATIC MACHINE CO., Inc., Windsor, Vermont
Agent for Michigan Territory: J. C. Austerberry, 684-690 E. Congress St., Detroit, Mich.
Chicago Representative: John H. Glover, 32 N. Clinton Street

Gold Seal
SEBASTIAN LATHES
GUARANTEED CORRECT
TRADE MARK

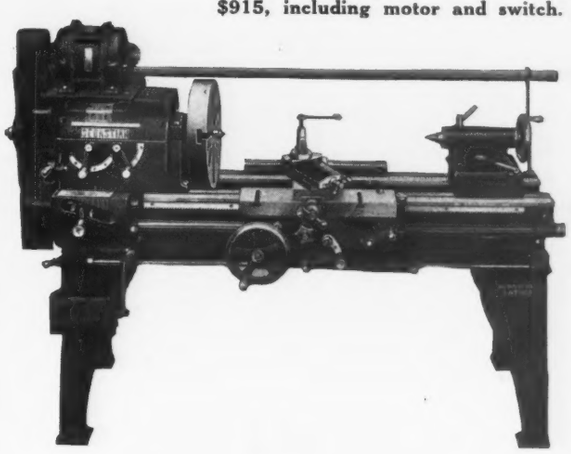
Gold Seal Quality

There's definite, visible quality in Sebastian Gold Seal Lathes. You can see it in the completed machine; you can see it being "built in" if you'll spend an hour or two with us some day; you can see it in the work performed by these machines.

We build 15-inch and 18-inch lathes only. Our efforts and our facilities are concentrated. We aim to produce a better product at a lower price. We offer you what we claim is the biggest lathe value on the market. Want to be shown?

GOLD SEAL VALUE

15" x 6' motor drive geared head quick change apron control. Price $915, including motor and switch.



The
SEBASTIAN LATHE CO.
154 Culvert Street
Cincinnati, Ohio

Victor

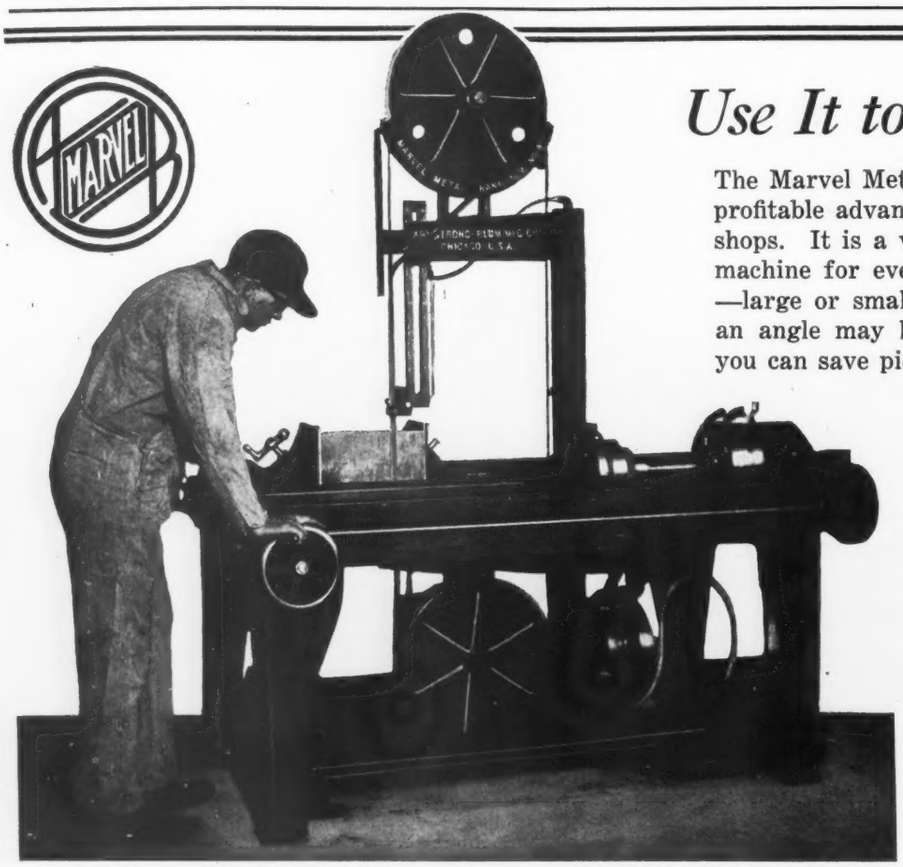
Hack Saws

"The Harder the Odds— the Greater the Victory"

VICTOR SAW WORKS
MIDDLETOWN, N. Y.

AVOID HACK SAW TROUBLES. WRITE FOR BOOKLET.

MARVEL



Use It to Your Profit

The Marvel Metal Band Saw can be used to profitable advantage in most metal working shops. It is a wide range, general purpose machine for every variety of metal sawing —large or small. Right or left sawing on an angle may be done; with this machine you can save piece of metal sawed out.

The head of the machine is always perpendicular; providing for square cutting on dies or tool-room operation. Large, roomy table with removable chuck jaws allows ample room for special jigs and bolting fixtures.

The Marvel catalog shows a complete line of metal saws for all purposes. Send for it.

ARMSTRONG-BLUM MFG. COMPANY, 343 N. FRANCISCO AVE. CHICAGO, ILL.

"Hunter" Quality Metal Cutting

SAWS and TOOLS

"Vanadium" Steel Rivet Sets

The shanks are faced to a slight radius which increases the effect of piston stroke on rivets.

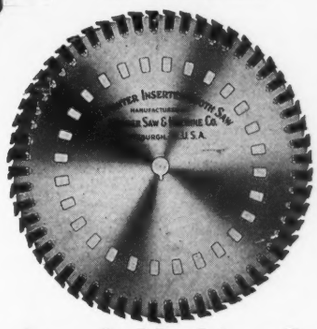
Inserted Tooth Saws

For rapid cutting with least vibration. Nut and Screw attachment for adjustment of teeth. Made to cut all metals. Sizes 10" to 90", Arbor or Sprocket drive.

Standard Chisel Blanks

Made from octagon stock. Sizes ¾" x 9", 13/16" x 9", and ⅞" x 8" carried in stock.

HARDENED STEEL SPECIALTIES



Write for Catalog

Hunter Saw & Machine Co.
Pittsburgh, Pa.

The

HIGLEY

COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.

New York Philadelphia New Haven

BARNES
SAWS FOR METAL
BAND MANUFACTURED BY HACK
DETROIT W. O. BARNES CO., INC. MICH.

LEA SIMPLEX COLD SAWS

There's a Lea-Simplex Booklet "Economy in Cold Sawing," that shows why the Lea-Simplex Cold Saw saves time, labor, material in cutting up raw stock. Send for it.

The Earle Gear & Machine Company
4707-15 Stenton Avenue PHILADELPHIA, U. S. A.
Also Manufacturers of Cut Gears, Special and Bridge Operating Machinery and Earle Centrifugal Pumps

RACINE

HIGH SPEED METAL CUTTING MACHINES

Used the World Over on the *finest* work

Money savers over and over on *ordinary* work

Ask any user. You will easily find the "Racine." Its use is world wide.

A multitude of reasons for the preference of the "Racine" may be summed up in the words, Accuracy—Speed—Economy.

"Racine's positive-lift" means that the blade ***cannot*** drag on the non-cutting stroke. It means blades that stay sharp longer, and ***last*** longer. It means saving in metal and finishing labor.

There's a Racine for Every Cutting Job

from the average work of the smallest shop to the finest work of the largest.

The wide range of the Racine Complete H. S. gives you the choice of the machine fitted to your needs. Belt or motor driven.

You will profit by the experience of leaders in any class of metal cutting work if you investigate the saving and satisfaction that have given the Racine its outstanding reputation. Send for new bulletin fully illustrating and describing all machines.

Use Racine H. S. Wood and Metal Band Saw Blades and Racine H. S. Tungsten Power and Hand Hack Saw Blades

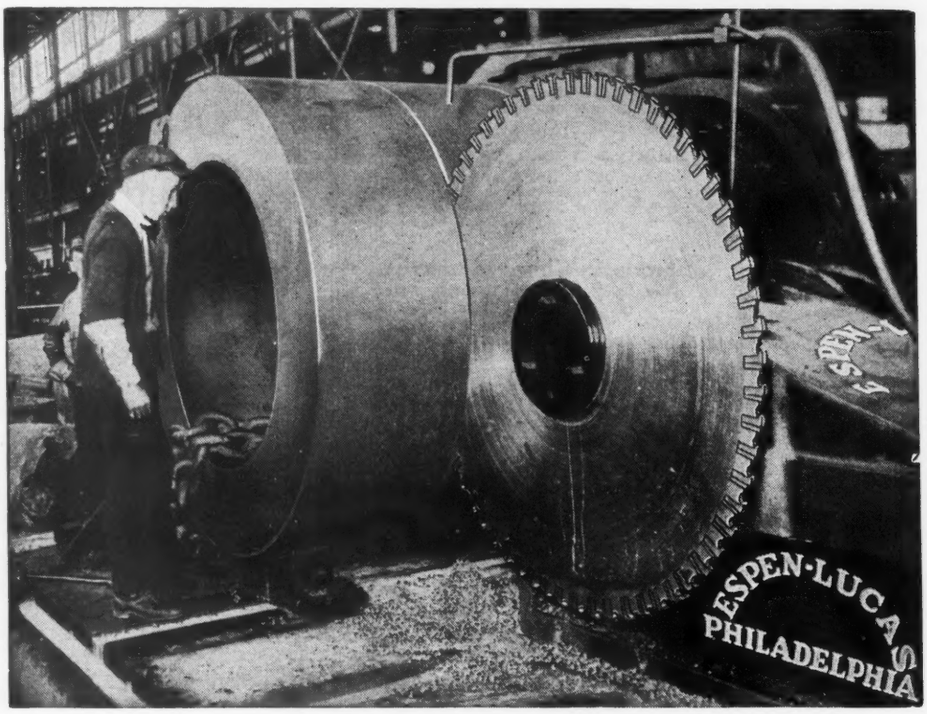
RACINE TOOL & MACHINE CO.
250-15th Street Racine, Wis.

"STANDARD THE WORLD OVER."

FAST AND ECONOMICAL SAWING

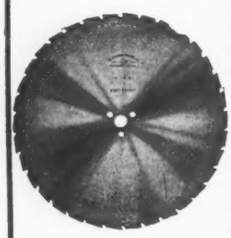
Tell us your needs, we have the knowledge, experience and will to correctly advise.

190 types and sizes of Sawing Machines for sawing all kinds of metal.



THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues **PHILADELPHIA, PA.**

Huther Saws are Rapid Producers



Huther Inserted Tooth Saws are rapid producers; they are also durable. Wear doesn't diminish their efficiency. The high speed steel teeth are so shaped that proper clearance is provided no matter how much they are ground.

Inserts may be worn back to about 3/16 inch thickness before it is necessary to replace them.

Tell us the size and material you use—we'll send the right saw. Catalog on request.

HUTHER BROS. SAW MFG. COMPANY, Inc.
ROCHESTER, N. Y.

QUALITY UNIFORMITY **"LENOX"** HIGH SPEED SERVICE DISTINCTION

HACK SAWS

"The Tools in the Plaid Box"

AMERICAN SAW & MFG. CO. SPRINGFIELD, MASS.
HACK SAWS - BAND SAWS - SCREW DRIVERS - GLASS CUTTERS

"STERLING"

BEST BY TEST

Fully Guaranteed

Free Booklet "Cutting Hack Saw Costs"

DIAMOND SAW & STAMPING WORKS, BUFFALO, N. Y.
357-361 Seventh St.

Please send me Free Booklet, "Cutting Hack Saw Costs." Address ..... Name ..... M.

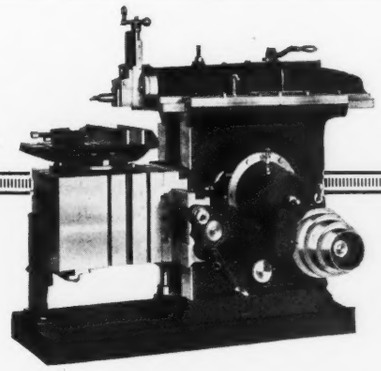
Shapers Exclusively

Crank Sizes: 12", 14", 16", 20", and 25"—Either Cone Driven or through Speed Box, 32" B. G.
All Geared Single Pulley Drive

THE SMITH & MILLS COMPANY
CINCINNATI OHIO, U. S. A.

SCREENS OF ALL KINDS
Chicago Perforating Co.
3445 West 24th Place
Tel. Canal 1459 CHICAGO, ILL.

Perforated Metal Machinery Guards



Shaper Requirements—

Tool-room, manufacturing, contract and repair shop work each makes special demands that are met in one machine by Columbia Shapers.

Special features—the Columbia quick change feed; quick stroke adjustment; improved rail clamp; special driving cone construction, etc.—give increased efficiency on both production and special work.

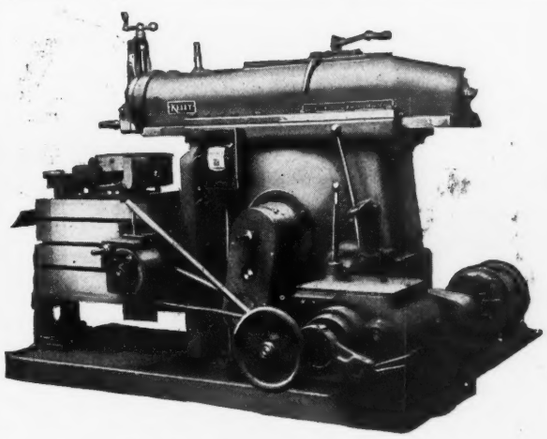
Generous proportions, wide range, ample power. Sizes 16 to 36 inch. Also with speed box, friction clutch and brake and single pulley or motor drive.

Details?

The Columbia Machine Tool Co.

HAMILTON, OHIO

Manning, Maxwell & Moore, Inc., Selling Agents, New York City and branches —Atlanta, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Milwaukee, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Syracuse.



Shop Talk on Crank Shapers

When you buy a Crank Shaper, get a good one. Get a Shaper that isn't limited by a narrow range of feeds and speeds; that won't get slack in the ways; that isn't skimpy with bearings.

Kelly Crank Shapers get a running test before shipment that satisfies us that you'll find everything from clutch to toolholder just as it ought to be. We'll make good if it isn't.

Sizes 14" Single Geared to 32" Back Geared. Better send for our Catalog and keep it handy against the day when you'll need a good crank shaper.

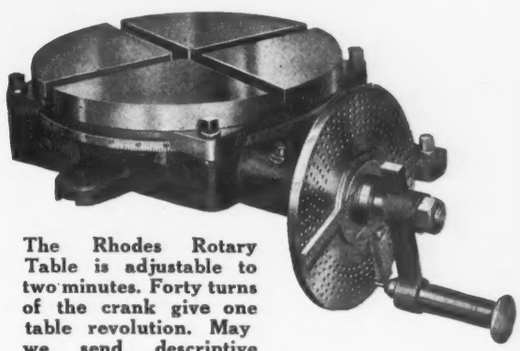
The R. A. Kelly Company

Xenia, Ohio, U. S. A.

Makers of Crank Shapers Only

A Device for Machining Curves and Angles

There are numberless uses for this table —many machines to which it is adaptable. On Milling Machine, Shaper, Slotter, Drill Press or Grinder, it will save time and money on work involving segments of circles and angles. No need to take down the job and reset.



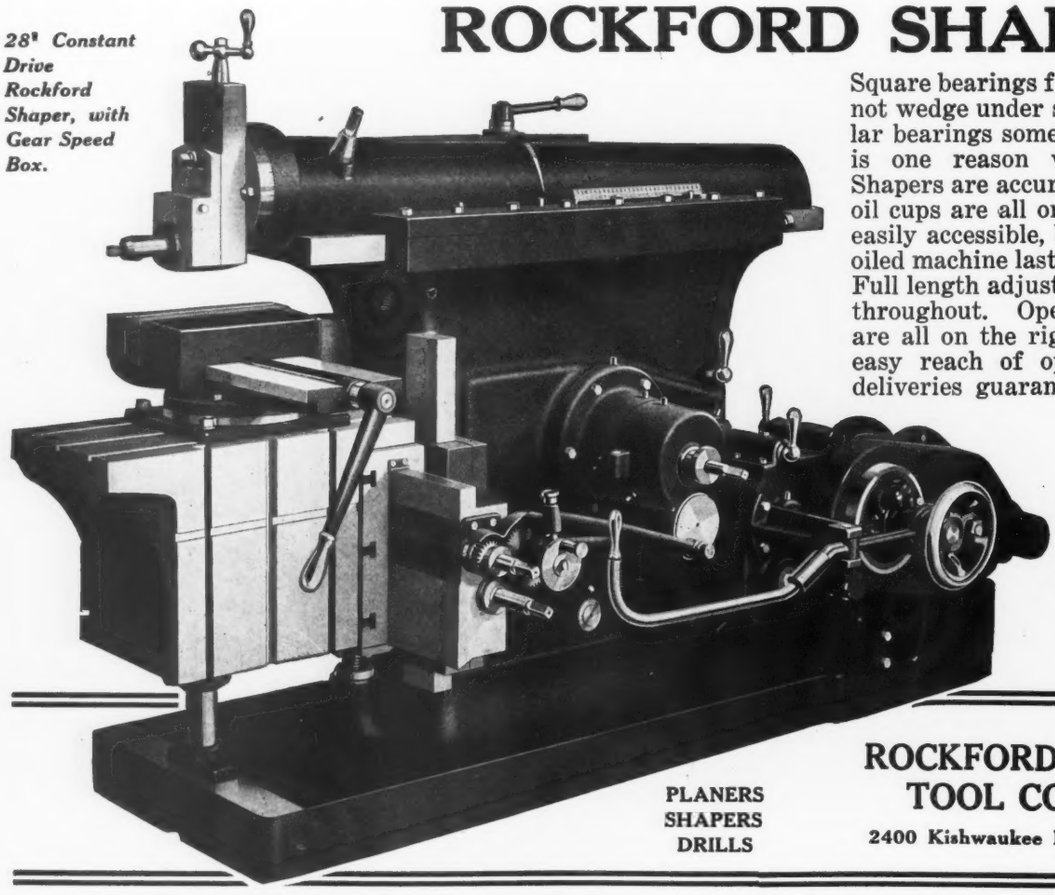
The Rhodes Rotary Table is adjustable to two minutes. Forty turns of the crank give one table revolution. May we send descriptive circular?

The Rhodes Manufacturing Co.

HARTFORD, CONN.

ROCKFORD SHAPERS

28" Constant Drive Rockford Shaper, with Gear Speed Box.



Square bearings for the ram will not wedge under strain as angular bearings sometimes do. That is one reason why Rockford Shapers are accurate. Rockford oil cups are all on the outside—easily accessible, because a well-oiled machine lasts twice as long. Full length adjustable taper gibs throughout. Operating levers are all on the right side within easy reach of operator. Quick deliveries guaranteed.

Let us describe Rockford Shapers in detail. Circular containing the whole story on request.

PLANERS
SHAPERS
DRILLS

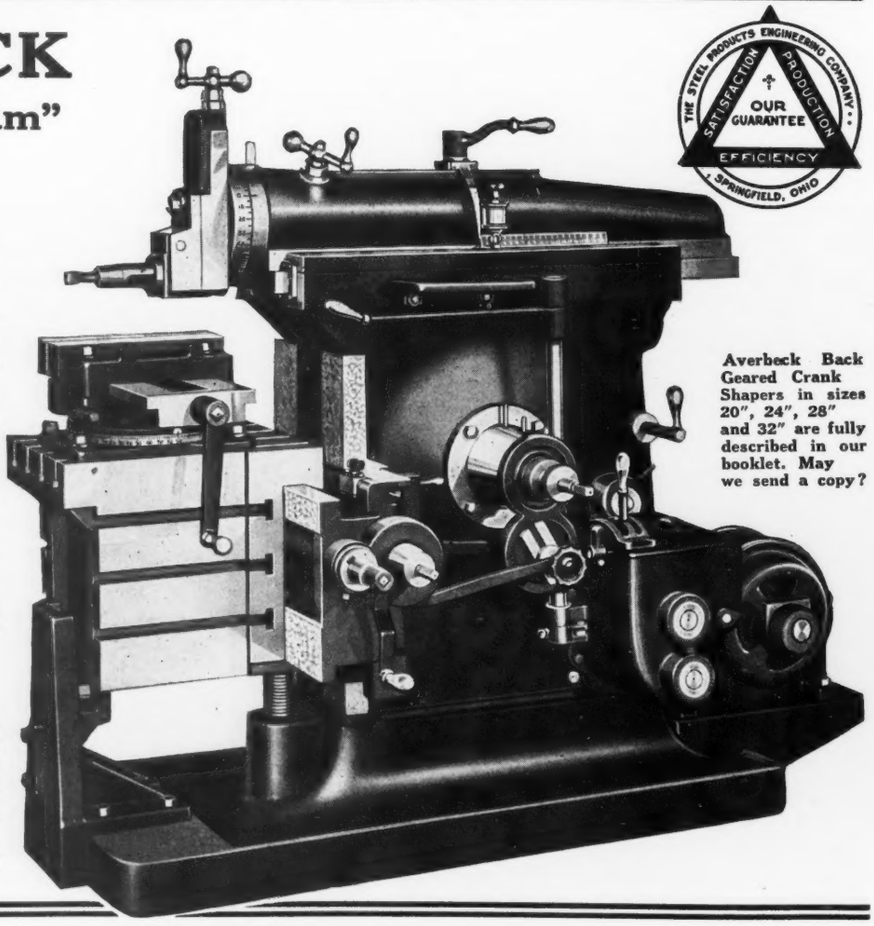
ROCKFORD MACHINE TOOL COMPANY
2400 Kishwaukee Rd., Rockford, Ill.

AVERBECK

The "Balanced Ram"

SHAPER

The Balanced Ram Mechanism makes the Averbeck one of the best shapers that ever pushed a tool! A counterweight on the rocker arm scientifically balances the weight of the ram. The result is *motion without momentum*—almost total absence of vibration, great accuracy at highest speeds, no chatter, less power consumed, and little need for adjustment or repairs.



Averbeck Back Geared Crank Shapers in sizes 20", 24", 28" and 32" are fully described in our booklet. May we send a copy?

THE STEEL PRODUCTS ENGINEERING CO.
Springfield, Ohio, U. S. A.

REPRESENTATIVES: Hess-Schenck Company, Cleveland, Ohio. J. L. Lucas & Son, Inc., Bridgeport, Conn. Haberkorn & Wood, Detroit, Mich. McCoy-Brandt Mchy. Co., Pittsburgh, Pa. Scott-Bansbach Machinery Co., Chicago, Ill. M. J. Walsh Machinery Co., Milwaukee, Wis. Buckner-Woodard Company, Seattle, Wash. Simmons Machine Tool Corporation, Buffalo, N. Y. Triplex Mch. Tool Corp., 50 Church St., New York, N. Y. Eccles & Davies, 320 So. San Pedro St., Los Angeles, Cal. Girard Machinery Co., Philadelphia, Pa.

DAYTON
(TORRINGTON)

Fast Production—An Unusual Operation

Five thousand in nine hours for swaging 5/8″ copper tubing (walls 1/32″ thick) to a point so perfect that the tube will hold water! The length of the taper is 5 1/2″, the tip is smooth and almost polished, free from cracks and rupture. The Geo. R. Kress Company had been pointing lightning rod tips by this method for more than six years when this photograph was taken, having found it faster, better, less expensive than any other method.

Dayton Swaging is uniformly accurate, always—whether the work swaged is copper tubing, iron pipe, trolley wire or gold spectacle frames.

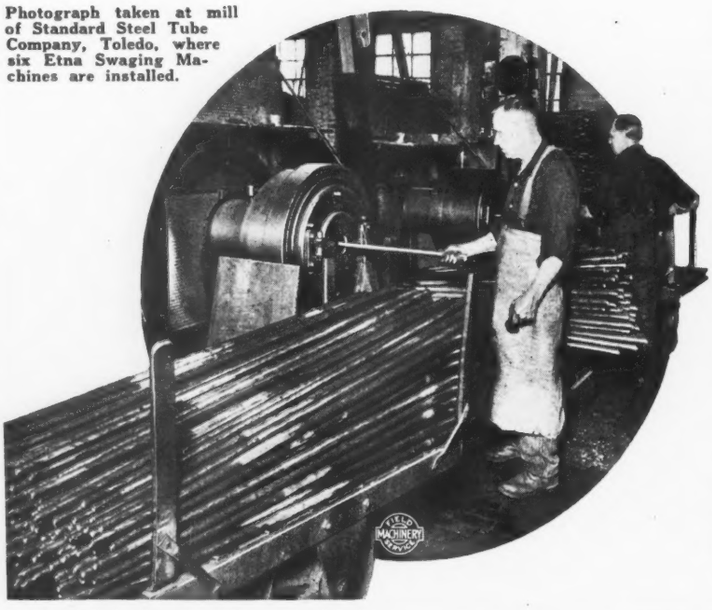
Dayton Swaging Machines are simple, durable, easily operated. Made in several sizes, send for details.

THE TORRINGTON CO.
Excelsior Plant
57 Field St., Torrington, Conn.
SUCCESSORS TO EXCELSIOR NEEDLE CO.

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

Tapering Tubes is Easy and Speedy with ETNA SWAGERS

Photograph taken at mill of Standard Steel Tube Company, Toledo, where six Etna Swaging Machines are installed.



The photograph shows two Etna Swaging Machines at work on No. 15 gage 59″ long lap-bronzed steel tubes, tapering end to end from 1½″ to 1″.

Etna Swaging brings the lesser diameter to 11/16″, the larger remaining at 1½″. This is accomplished in two operations, one on each machine. Production averages 3000 tubes per man in an eight-hour day.

These machines will cut costs for you, too. Let us tell you how

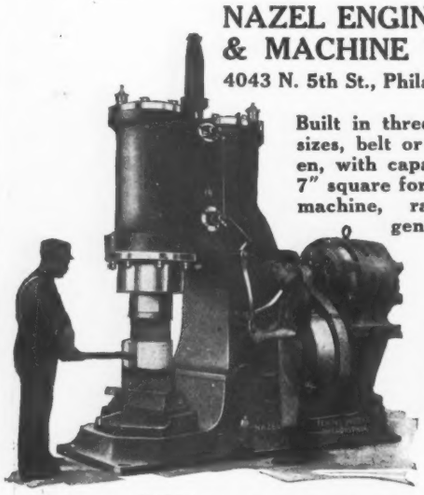
The Etna Machine Co.
Maplewood Ave. and Castle Blvd.,
TOLEDO, OHIO

The Matter of Utility

If it's a Nazel Air Hammer it can be utilized on any kind of forging instantly—requires no working out, but starts immediately as soon as power is turned on and maintains the same suitable speed from start to finish.

All manner of railroad, machine and general forging commonly done under steam hammers can be done with a decidedly lower operating cost and upkeep under Nazel Hammers, especially so when motor driven.

NAZEL ENGINEERING & MACHINE WORKS
4043 N. 5th St., Philadelphia, Pa.



Built in three types. Six sizes, belt or motor driven, with capacities up to 7″ square for all kinds of machine, railroad and general forging.

Write for the NAZEL Hammer Book It's free

NAZEL HAMMERS require no storage tanks, independent compressors or piping

American 18 inch Vertical Broach Press

Send for a complete catalog of American Broaching Machines; see our Power Broach Press advertisement on another page.

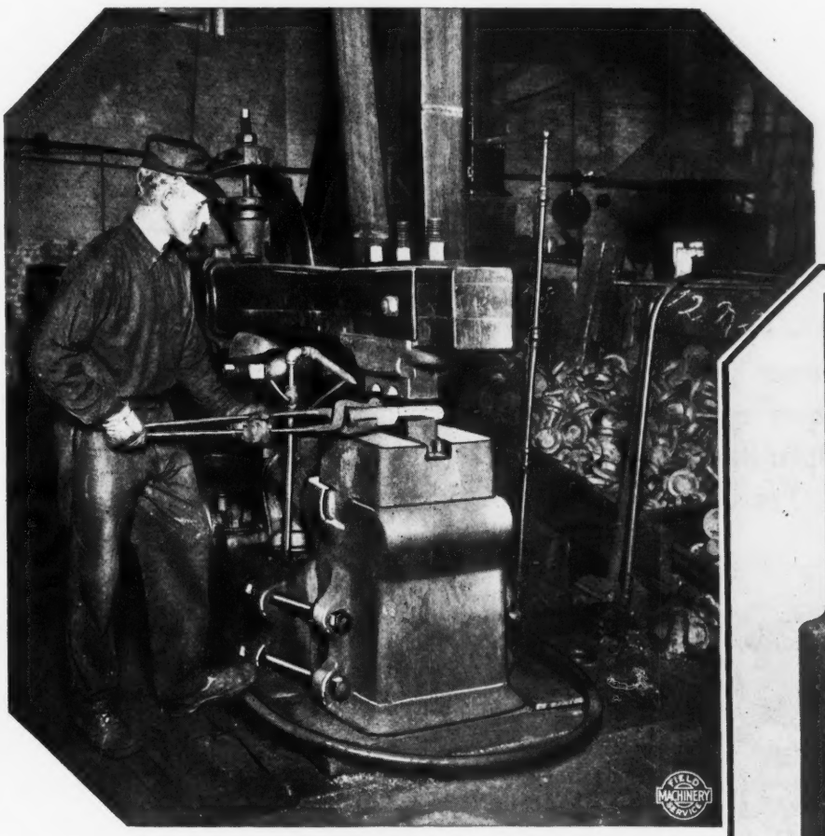
Big profits from a moderate investment. Capacity 6 to 8 tons pressure; maximum stroke 18″; 12″ between frames. A machine that is efficient on assembly work and will replace an arbor press on many operations.

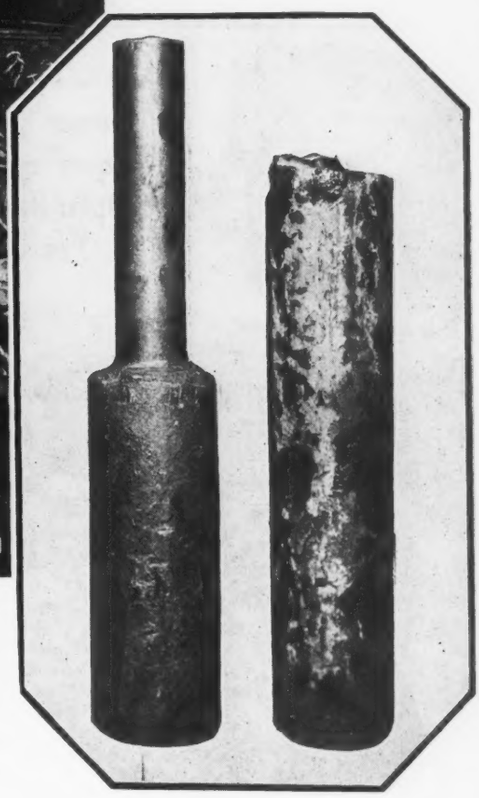
American Broach & Machine Company
Builders of All Types of Broaching Machines and Broaching Tools
ANN ARBOR, MICHIGAN

Detroit Office, 2496 E. Grand Boulevard. Phone Empire 5673. Cleveland, M. Jaeger, 4500 Euclid Ave. Chicago, T. J. Davis, 550 W. Washington Blvd. Toledo, National Supply Co., 136 Huron St. Minneapolis, Northern Machinery Co., 5th Ave. S. and 6th St. Jamaica, N. Y., Frank G. Kernan, 8 King St.

A Bradley Hammer

Draws Down 700 of These in 8 Hours





THESE cylindrical shafts for De Laval Cream Separators are drawn down to 1¼" from steel billets 2½" in diameter in a little more than 4 seconds each—a production rate that sets a profitable pace for the upsetting operation which follows.

This is one of two Bradley Hammers in the Poughkeepsie, N. Y., plant of the De Laval Separator Company. For six years both of them have been doing excellent work at low costs. A substantial profit has been earned because of the accuracy, power, productivity and convenience of these Bradley Hammers as one-man units for drawing down, welding, tool dressing, die work, etc.

If you handle work within the Bradley range let us show you how these hammers can save money for you. Write us.

"Forge Ahead with a Bradley Hammer"

C. C. BRADLEY & SON, Inc.

432 North Franklin Street

SYRACUSE NEW YORK

ESTABLISHED 1832

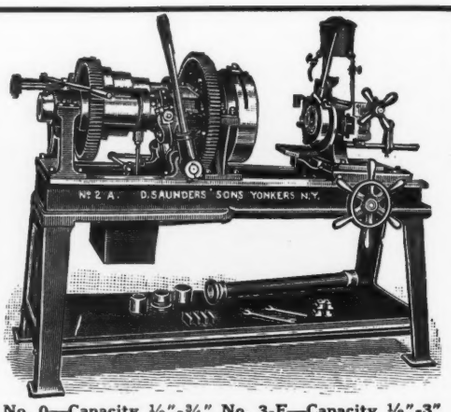
Run the Saunders at Highest Speed You Can't Hurt It!

And get production that will put new profit in your pipe threading, cutting and nipple threading..

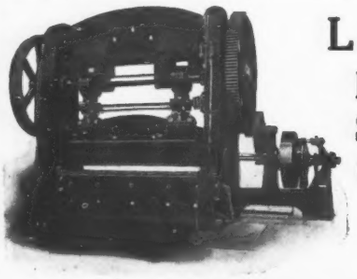
Saunders Pipe Threading and Cutting Machines are equipped with Chucks, Expanding Die-heads and Nipple Threading Attachments that operate instantly—while the machine is in motion. The time saved between cutting operations by these speedy devices makes the Saunders worth its purchase price many times over.

Machines for all pipe up to 18 inches. Send for catalog P.

D. SAUNDERS' SONS, Inc., Yonkers, N. Y.

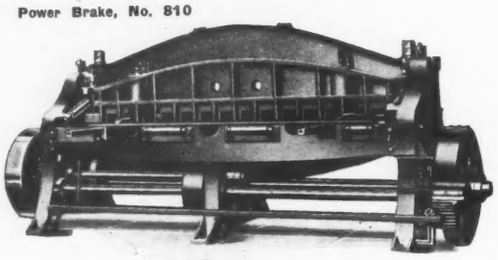


No. 0—Capacity ⅛"-¾" No. 3-F—Capacity ½"-3"
No. 2-A—Capacity ¼"-2" No. 4-C—Capacity 1"-4"



L & N
Power Brake
Squaring Shear
Open Back
Press

Power Brake, No. 810



Squaring Shear, No. 3010

Open Back Press No. 324

We manufacture power brakes, or forming presses and squaring shears in capacities from 16 gauge to ⅜ in., front 4 feet to 12 feet in length. We also manufacture Mitre Presses, special sheet metal machines, forming and mitre dies, and shear blades.

Loy & Nawrath Division
Birmingham Iron Foundry
DERBY CONN.

Power Punching and Shearing Machinery

SPACING TABLES
FOR WORKING PLATES, BARS AND STRUCTURAL SHAPES

The Long & Allstatter Company
HAMILTON, OHIO

Hurlbut, Rogers Cutting-off Machine

Have patented features found in no other machines; speeds and feeds to suit all metals. Capacity to 10" stock.

Write for catalog

THE HURLBUT, ROGERS MACHINERY CO.
Nashua, N. H.

MERRELL
Pipe Threading and Cutting Machinery

Hand or Power Operated

THE MERRELL MFG. COMPANY
15 Curtis Street TOLEDO, OHIO

CHAMBERSBURG

Steam, Steam Drop and Board Drop Hammers
Trimming Presses Punches and Shears
Hydraulic Machinery of all types and sizes, including Presses, Riveters, Pumps, Accumulators and Special Machinery.

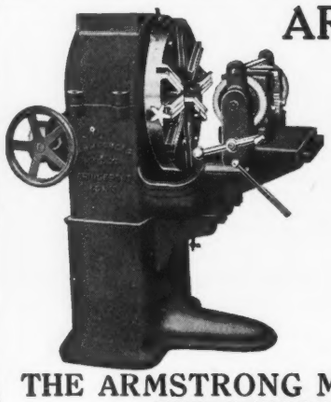
CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa.

Threading Machines

Pipe—"Better Threads at Lower Cost"—**Bolt**
Belt or Motor Driven—Range ⅛" to 24"

Write for our 1924 Catalog

WILLIAMS TOOL CORPORATION
Canadian Plant: Brantford, Ont. ERIE, PENNA.



ARMSTRONG
No. 3
Pipe Threading Machine

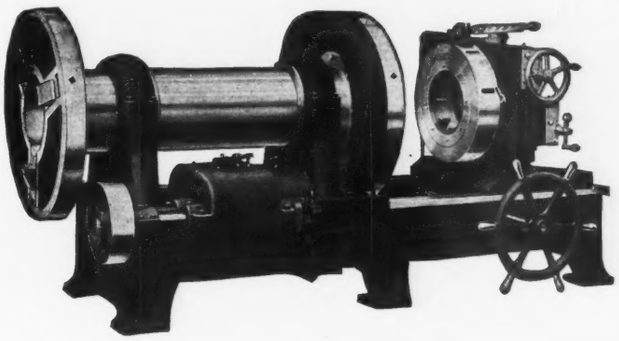
POWER ONLY

Threads Pipe 1 inch to 6 inches right or left.

MANUFACTURED BY

THE ARMSTRONG MFG. COMPANY
BRIDGEPORT, CONN.

PEERLESS B&K DUPLEX P.D.Q.C



Keeping Close to Mother Earth

The only part of the driving mechanism of this machine above the machine bed is the master gear, and this is bolted securely to the gripping chuck, and is driven by a series of steel gears through which the desired speed changes are obtained.

There is no weak point—let us quote price.

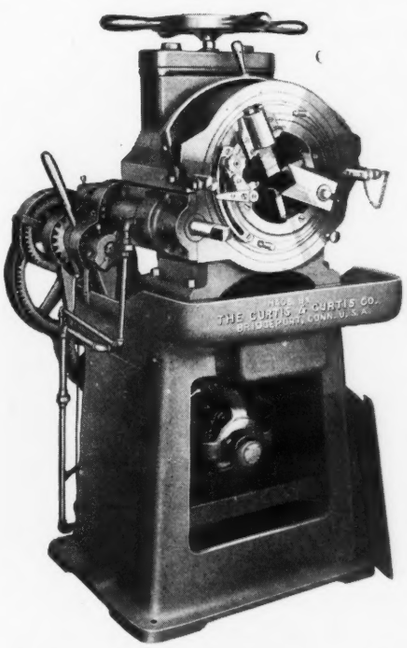
BIGNALL & KEELER MACHINE WORKS, Edwardsville, Ill.

Sales Agents: Manning, Maxwell & Moore, New York, N. Y.

Chicago Philadelphia Buffalo Boston Syracuse St. Louis Detroit Pittsburgh Milwaukee Cleveland San Francisco New Haven Seattle Cincinnati

The New Forbes

Pipe Cutting and Threading Machines



So easy to take to the job

This plumbing contractor counts increased profits from the day he invested in this New Forbes Pipe Cutting and Threading Machine.

The operating method, by which pipe of all sizes to capacity (16″ in the largest Forbes), of any length, with any bends, angles, etc., is held stationary while the threading dies revolve around it, makes it valuable for work "on the job"; compact construction makes it *easy to take to the job.*

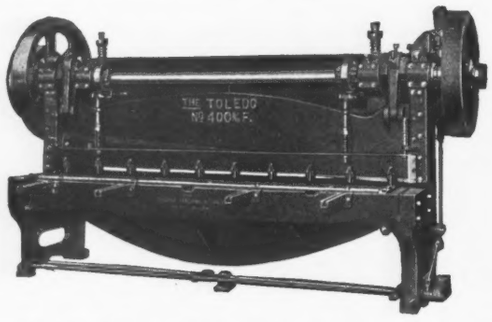
Design and special features—Three Point Vise; Automatic Die Release; Improved Interchangeable Chasers, etc., make the New Forbes profitable on all kinds of pipe threading, everywhere.

Let us tell you about this machine.

THE CURTIS & CURTIS COMPANY, 324 Garden Street Bridgeport, Conn., U. S.

THE "TOLEDO"

PRESSES FOR EVERY PURPOSE!



"Toledo" Shears are built in 100 sizes from 1500 to 100,000 pounds. Rapid, Accurate, Efficient; popular wherever sheet metal—from tin to steel—is cut. For details of the Toledo Shears see Catalog Section 11-A. Toledo Power Presses are made to suit all needs, over 2000 standard models, special machines developed where necessary.

The Toledo Machine & Tool Company

TOLEDO, OHIO

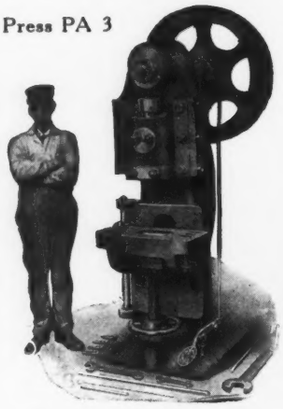
Chicago Office: 549 West Washington Blvd.
Detroit Office: Room 3-250, General Motors Bldg.

Founders, Machinists and Engineering Specialists on Equipment for Sheet Metal Products.

FERRACUTE PRESSES

For Cutting and Forming Metals

Press PA 3



Press PA 3, shown above, is an adjustable bed Punching and Horning Press. When used for horning, the bed swings to one side.

Six sizes.

Geared when desired.

Press E 14, shown below, is an inclined Embossing Press with solid columns set close together; the work sliding down back by gravity.

Six sizes.

Also built with gearing.

Press E 14

Presses for Every Purpose

FERRACUTE MACHINE CO., BRIDGETON, NEW JERSEY

The King Pressure Toggle

A Permanent Attachment that equips a Single Action Press to produce Toggle Press jobs.

More Uniform Work with a Saving of 25% to 60% in Production Cost and 40% to 60% in First Cost of Equipment.

R. D. KING Chicago, Ill.

1620 Monadnock Block

ATLAS PRESSES

for

Driving Mandrels, Bending, Straightening, Broaching, Embossing, etc. Presses of all types and sizes for all classes of work.

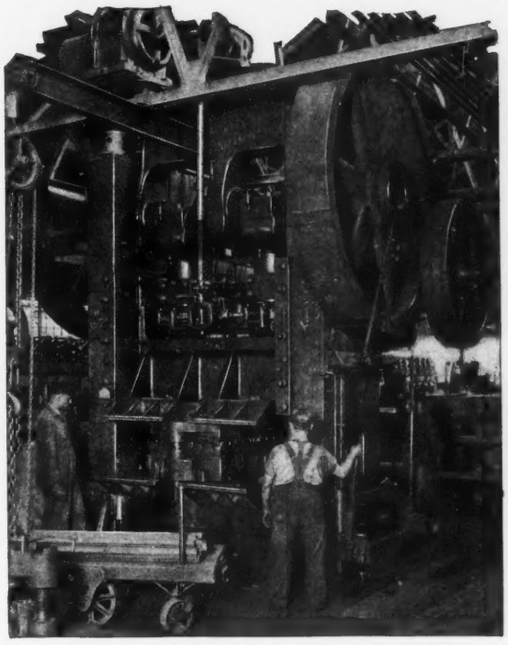
The cut shows the Atlas No. 3 Arbor Press equipped with the Atlas patent leverage device which enables the operator to exert enormous pressures.

Simple or compound leverage instantly available.

ATLAS PRESS COMPANY

Kalamazoo Mich., U. S. A.

When costs *must* be reduced—
a Lesson from the Automotive industry



THESE DAYS, successful automobile and tractor manufacturers must estimate the price that prospects can afford to pay for their machines and then make their costs come within that figure. With such a standard, the wide use of BLISS Presses in automobile and tractor manufacture is doubly significant of the highly economical production which they assure.

If you are interested in reducing the cost of *your* sheet metal working operations and at the same time improving the quality of your product, it will pay you to investigate the possibilities of BLISS Presses in your plant.

Bliss for Machinery

E. W. BLISS CO. BROOKLYN N. Y., U. S. A.

Factories: BROOKLYN, N. Y. HASTINGS, MICH. CLEVELAND, O. SALEM, O.
Sales Offices: DETROIT CLEVELAND CHICAGO PITTSBURGH ST. LOUIS BUFFALO CINCINNATI NEW HAVEN ROCHESTER
Foreign Factories & Offices: LONDON, ENG. TURIN, ITALY PARIS, FRANCE

BLISS

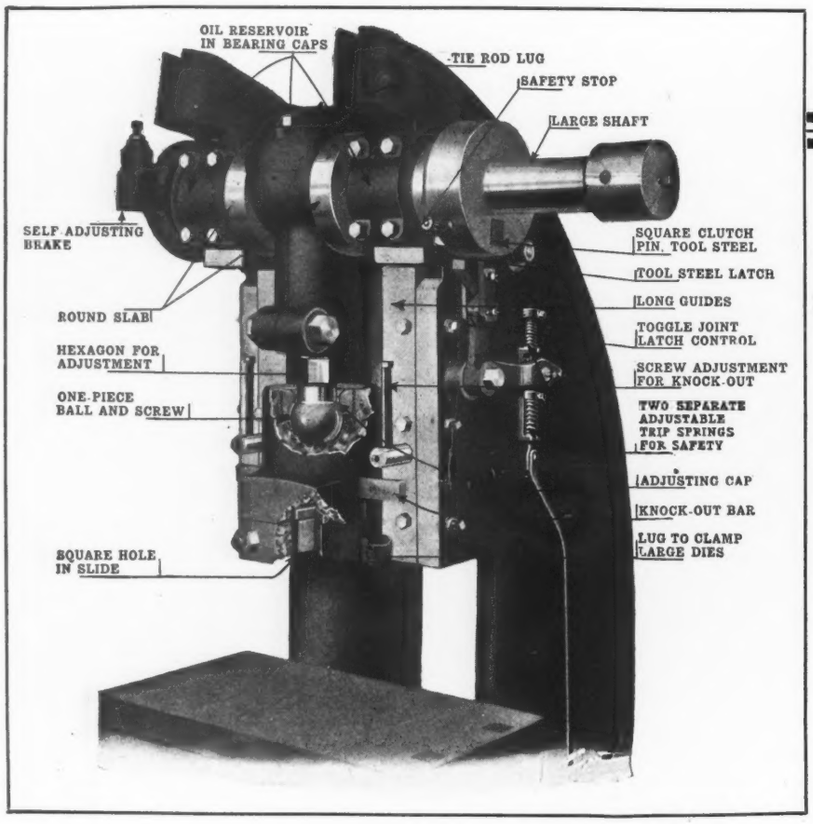
No. 364

Some sheet metal products made by Bliss Presses

Agricultural Implements
Aluminum Ware
Armature Disks and Segments
Automobile Parts
Bicycle Parts
Bird Cages
Bottle Caps and Capsules
Brass Goods
Brittania Ware
Buckles
Burners
Butter Tins
Cash Registers
Cigarette Boxes
Clocks
Coal Hods
Collapsible Tubes
Cooking Utensils
Coins
Cornice Work
Cuspidors
Cutlery
Dinner Pails
Drip Pans
Door Knobs
Drop Forgings
Druggists' Tinware
Dust Pans
Electrical Goods
Elevator Buckets
Enamel Ware
Expanded Metal Lath
Fish Cans
Forks
Fruit Cans
Fry Pans
Furniture (Metal)
Gas Fixtures
Gas Ranges
Gun Parts
Hammers
Hardware
Harness Trimmings
Hinges
Horse Shoes
Jewelry
Kitchen Boilers
Kitchen Utensils
Lamps
Lanterns
Lard Pails
Locks
Meat Cans
Medals
Metallic Ceilings
Metal Lath
Metal Radiators
Musical Instruments
Oil Cans
Oil Stoves
Perforated Metal
Paint Cans
Paint Tubes
Petroleum Cans
Pick-eyes
Pieced Tinware
Plated Ware
Playing Cards (Cutting)
Powder Kegs
Range Boilers
Range Parts
Reflectors
Refrigerators
Roofing
Satchel Frames
Silver Ware
Sheet Steel Sinks
Shingles (Metal)
Shovels
Spoons
Sheet Steel Stoves
Steel Barrels
Stove Trimmings
Tin Boxes and Cans
Toys
Trunk Trimmings
Typewriters
Vapor Stoves
Varnish Cans
Vegetable Cans
Water Coolers
Water Pails
Watches
Wash Tubs

BLISS

Since 1857

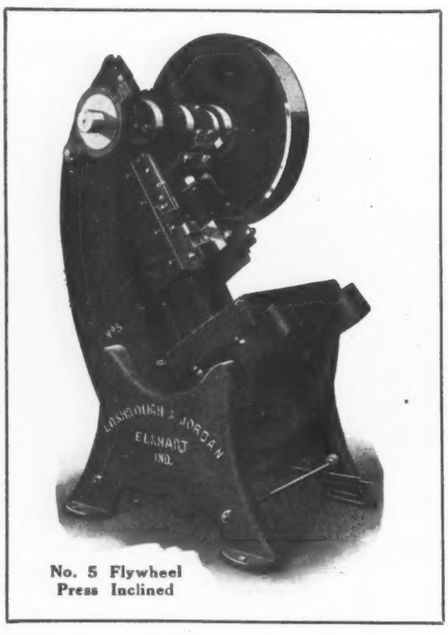


Guarantee

If within one year of purchase the shaft or frame of a Loshbough - Jordan Press breaks while operating within its rated speed, we will replace the broken parts gratis.

Loshbough-Jordan Tool & Machine Co.

Let's get to the Heart of the Press Question



No. 5 Flywheel Press Inclined

You mechanical men know that what's inside a press makes it good, bad or indifferent. You can't know a man until you know what's in his heart, nor can you know a press until you know what's in it—how it is made, and what it is made of.

Here is a cut-away view of a Loshbough-Jordan Open Back Inclinable Press, with its construction features indicated—to try to convey to you an idea of how it is made.

It looks good doesn't it, stripped for inspection? And it looks better stripped for action! If you'd like to see a Loshbough-Jordan Press call on any dealer listed below. You'll find our presses on display.

Meanwhile, write us asking about our 30-day free trial offer.

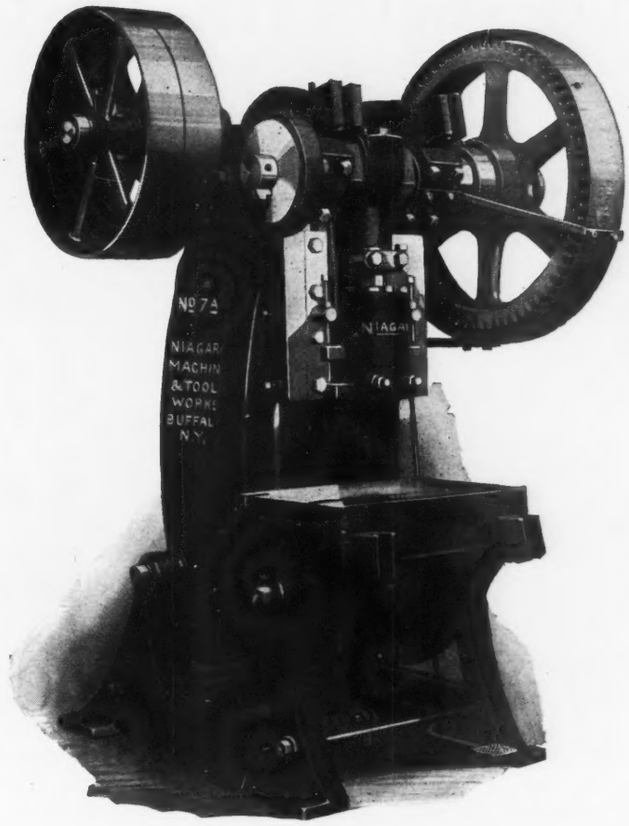
Send for the catalog.

LOSHBOUGH-JORDAN TOOL & MACHINE CO.

ELKHART, INDIANA, U. S. A.

Dealers: Herberts Machinery & Supply Co., San Francisco and Los Angeles, Cal. Northern Machinery Co., Minneapolis. Brown Machinery Co., St. Louis. English Tool & Supply Co., Kansas City, Mo. Stocker-Rumely-Wachs Co., Chicago. Riverside Machinery Depot, Detroit. Cleveland Duplex Mchy. Co., Cleveland, O. Reliance Machy. Sales Co., Pittsburgh. M. D. Larkin Supply Co., Dayton, Ohio. Joseph Beal & Co., Boston, Mass. J. L. Lucas & Son, Inc., Bridgeport, Conn. G. T. Reynolds & Son, Providence, R. I. Triplex Machine Tool Co., New York City.

SHEET METAL WORKING MACHINES & TOOLS



Inclinable Open Back Power Presses

Adapted for use in operating nearly every kind of cutting, drawing, forming, perforating, and combination dies. They are used extensively in the manufacture of metal stampings, including can and tinware parts, electrical goods, automobile parts, gaskets, hinges, metal novelties, toys, cash register parts, boxes for pills, ointments, etc., typewriter and adding machine parts and numerous other items of similar nature.

Details of our complete line of presses, shears, punches, etc., are given in the following list.

No. 58—Inclinable Open Back Presses
No. 59—Bench Power Press
No. 60—Power Horn Presses and Side Seamers
No. 61—Power Punching Presses
No. 62—Power Arch Presses and Open Back, Gap Presses
No. 63—Straight Sided Single Crank Power Presses and Trimming Presses
No. 64—Double Crank Power Presses (Built Up Frame)
No. 65—Double Crank Power Presses (One Piece Frame)
No. 66—Toggle and Cam Presses
No. 67—Power Punches, Single, Multiple, etc.
No. 68—Foot Operated Presses
No. 70—Power Rotary Shears
No. 71—Power Squaring Shears (Light)
No. 72—Power Squaring Shears (Medium)
No. 73—Power Squaring Shears (Heavy)

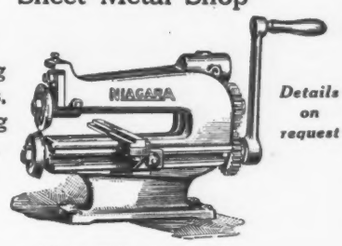
Send for Bulletins of interest to you.

NIAGARA MACHINE & TOOL WORKS
Established 1879
BUFFALO, N. Y.

The Smaller Sheet Metal Working Machines and Tools are described in our Catalog No. 56—Send for a copy.

Handy For the Sheet Metal Shop

Slitting Sheets, Cutting Discs, etc.

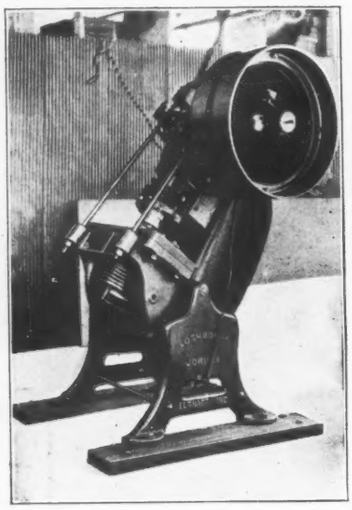


Details on request

No. 2 Slitter Patented

NIAGARA

MARQUETTE PNEUMATIC DIE CUSHIONS



Will save you money and increase both the quantity and quality of your shells.

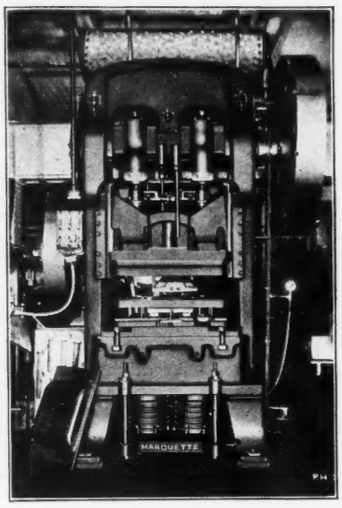
They will increase the capacity of your press, reduce the number of operations, provide an even pressure on all parts of blank, eliminate high tension at the end of the stroke, save time in changing dies and do eight other things essential to good work and increased production which are covered in detail in our catalog.

335 Manufacturers using 2,153 Marquette Pneumatic Die Cushions are producing better shells at a lower operating cost.

The Fisher Body Corporation, noted for high efficiency, has in use 445 of these pneumatic die cushions.

Write for catalog and become better acquainted with the Marquette Pneumatic Die Cushion.

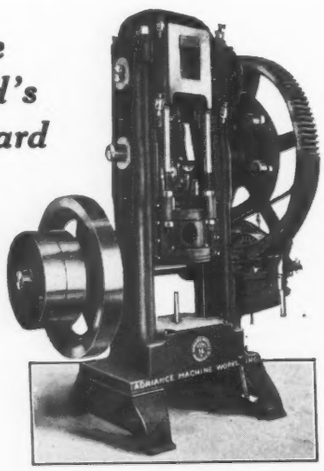
Our engineering department is at your service.



MARQUETTE TOOL & MFG. COMPANY

321 W. Ohio Street, Chicago, Illinois

The World's Standard



"ADRIANCE"

Combined Drawing and Reducing Presses

Built in four sizes to meet requirements of the trade. These presses are very efficient in operation and have excess power for depth of draw compared with stroke of crank. Upper crankshaft operates blank-holder, lower crankshaft, the inner plunger. Unique construction of these presses readily accommodates dies to the usual trade requirements.

ADRIANCE MACHINE WORKS, Inc.

Established 1888 *Incorporated 1913*

78 RICHARDS STREET, BROOKLYN, N. Y.

Pacific Coast Representatives: Waterhouse & Lester Co., 540 Howard St., San Francisco

Sole Agents for Great Britain: Buck & Hickman, Ltd. 6 Whitechapel Road, London

BEAUDRY HAMMERS

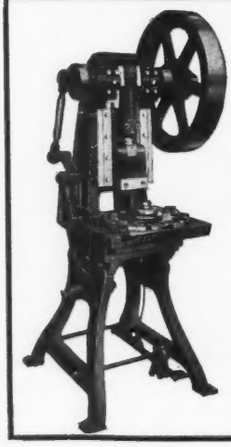
For General Forging

A Paying Investment if used but an hour a day. 50 to 500 lbs.

Belt or Motor Driven

Beaudry Company, Inc.

Everett, Mass.



Sure Money Savers!

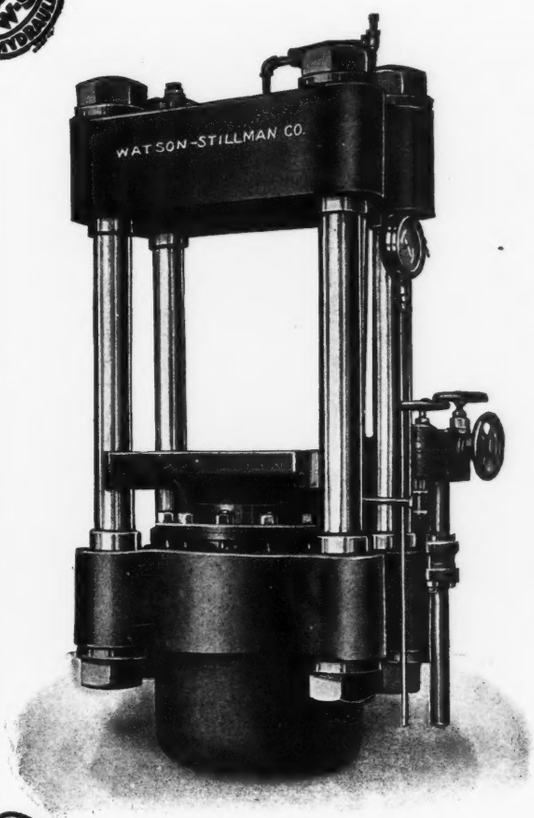
Littell Automatic Feed Devices for Punch Presses are positive profit-earners. Practically All Littell Feeds have paid for themselves in less than three months—after that, saving was all clear profit.

Let us send details.

F. J. LITTELL MACHINE COMPANY

4125-27 Ravenswood Ave.

Department M **CHICAGO**



Do you know that many of the operations you are now doing on drop hammers and toggle presses can be done best on

Hydraulic Presses?

The Watson-Stillman Line offers many examples of presses for a great variety of die forming, forcing, etc., and by the addition of plates to the platens, adaptable to a wide range of heating and chilling operations.

Other machines of our manufacture are benders, bulldozers, jacks, pit jacks, shaft straighteners, rail benders, punches, shears, wheel presses, forcing presses, forging presses, crank pin presses, pumps, accumulator, valves, etc.

Write for Catalogs

THE WATSON-STILLMAN CO.
192 Fulton St., New York
McCormick Building, Chicago
Philadelphia, Widener Bldg.
Cleveland, Leader-News Bldg.

The press shown here is built in capacities of 150 to 1000 tons, with platens up to 30x30 in.

433

Hydraulic Presses and Valves, Power Pumps and Accumulators

for

Straightening Castings, Moulding Bakelite, Hubbing, Broaching, Forming, Flanging

25 years' experience making hydraulic equipment. We design especially for your requirements. Write for catalog.

The French Oil Mill Machinery Co.
PIQUA, OHIO

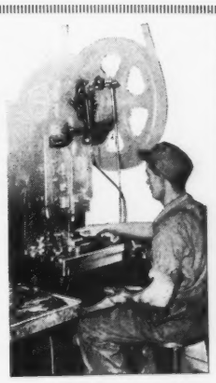
Safety and Speed

The improved Wiesman Safety Guard sweeps the *entire* length of Bolster Plate on *half* of downward stroke of Punch.

This means that *both* hands of operator are protected.

The Guard Arm returns *beyond* the center of ram on *half* of upward stroke. This allows the operator to feed *fast*, knowing that he is *safe* if the press *repeats*.

No Adjustments When Changing Dies



Attached in One Hour
30 Days' Free Trial

THE WIESMAN MFG. CO.
31 to 35 So. St. Clair St., Dayton, O.

Southwark Stock Machinery

STANDARD TOOLS for BOILER, FORGING and SHEET METAL WORKING SHOPS

A large stock of hydraulic and power tools enables us to make prompt shipment on many standard tools. Special machines will be built to suit the manufacturers' requirements.

It will pay you to let us know what machinery you need.

AMONG OUR STANDARD PRODUCTS

Four Column Flanging Presses
Sectional Flangers
Bending Presses
Bulldozers
Bushing Presses
Wheel Presses
Forging Presses
Riveters, Hydraulic and Pneumatic
Bending Rolls
Vertical and Horizontal Punches
Hydraulic and Power Shears
Rotary Shears
Jacks
Hydraulic Pumps
High Pressure Valves and Fittings
Accumulators
Hydraulic Pipe
Flue Welders
Flue Testers
Washer Presses
Angle Benders
Upsetting Presses
Shaft Straighteners
Spring Machinery

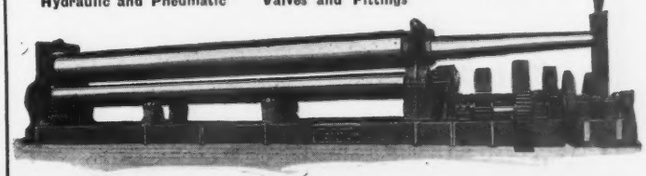
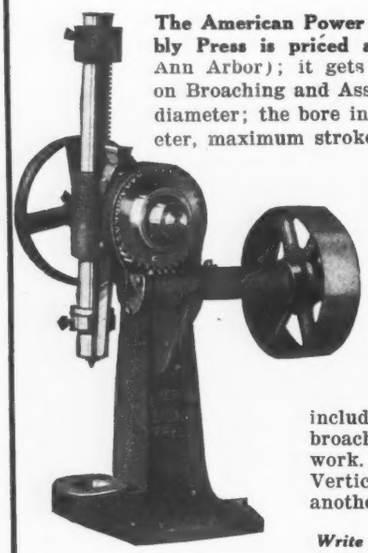


Plate Bending Rolls, all types, sizes and capacities.

SOUTHWARK
FOUNDRY AND MACHINE CO.
ESTABLISHED 1836
PHILADELPHIA, PA.

Fisher Bldg., Chicago. **Swetland Bldg., Cleveland.**

Price—Production—Cost



The American Power Broach and Assembly Press is priced at $120.00 (F.O.B. Ann Arbor); it gets exceptional results on Broaching and Assembling work to 6" diameter; the bore in table is 2½" diameter, maximum stroke 14", pressure to 2 tons; production is high manufacturing, operating upkeep costs are low. A profitable machine.

American Broaching Equipment

includes machines and broaches for all classes of work. See details of our Vertical Broach Press on another page.

Write for a complete catalog.

American Broach & Machine Co.

Builders of All Types of Broaching Machines and Broaching Tools

ANN ARBOR MICHIGAN

Detroit Office, 2496 E. Grand Blvd., Phone Empire 5673.
Cleveland Representative, M. Jaeger, 4500 Euclid Ave.
Chicago, T. J. Davis, 550 W. Washington Blvd.
Toledo, National Supply Co., 136 Huron St.
Minneapolis, Northern Machinery Co., 5th Ave. S. and 6th St.
Jamaica, N. Y., Frank G. Kernan, 8 King St.

EST. 1851 **ELMES** INC. 1895

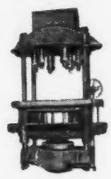
HYDRAULIC SHOP PRESSES

Portable Jacks 10 to 1000 tons
Place in any position any distance from the work.

400-Ton Portable Forcing Press.

Truck Tire Forcing Press
Six Designs. Different capacities.

250-Ton Rail Bender.



Auto Body Forming Press.

Forging Press.

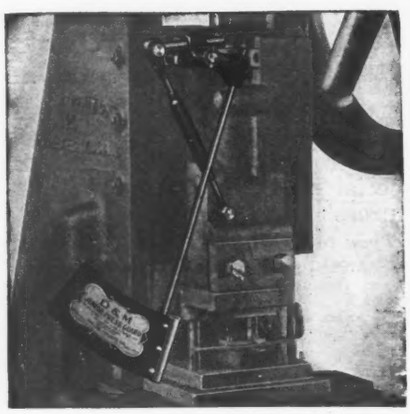
Bushing Press.

Accumulator.

CHARLES F. ELMES ENGINEERING WORKS

222 N. MORGAN ST. CHICAGO, ILL., U. S. A.

PROTECTION



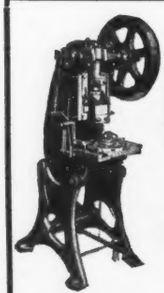
D & M Junior Press Guards

protect the operator without slowing up the machine; they actually increase production.

Simple, easily attached, low cost—try a D & M *free* for 30 days. In writing for details mention name, size and stroke of press.

TAYLOR-SHANTZ COMPANY

485 St. Paul Street, ROCHESTER, N. Y.

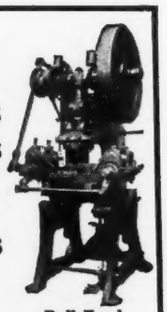


S&S

Precision Automatic Feeds Fit Any Make Punch Press

SIMPLE AND DURABLE

Quick Loading Reels For Coiled Stock



Dial Feed

Roll Feed

AUTOMATIC METAL WORKING MACHINERY

S & S MACHINE WORKS

4522 W. Lexington Street CHICAGO, ILL., U.S.A.

V & O POWER PRESSES

and THREAD ROLLING MACHINES

V & O PRESS CO., HUDSON, N. Y.

AUTOMATIC BAIRD MACHINE CO. BRIDGEPORT, CONN.

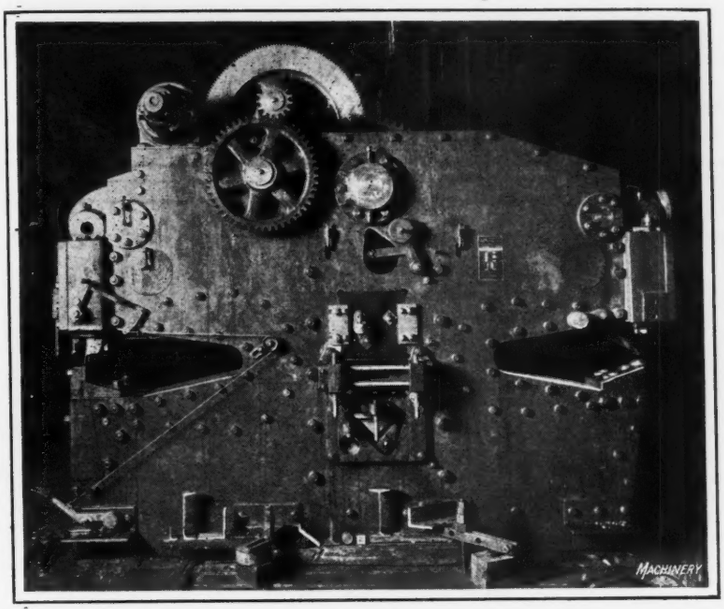
PRESSES—Foot and Power.
WIRE FORMING MACHINES—Standard or Special.
TUMBLERS—All kinds.
BALL BURNISHING EQUIPMENT.
AUTOMATIC CHUCKING MACHINES

BAIRD MACHINE CO.
BRIDGEPORT, CONN.

"Buffalo"

"Armor Plate" Combination Punch, Shear and Special Bar Cutter

This machine easily cuts 12" beams and channels, 6" x 1" flats, and 6" x ¾" angle square, or 4½" x 9/16" angles on a mitre, with knives *that are always in and ready.*



Always set and ready—tool changing eliminated - it is a great time saver

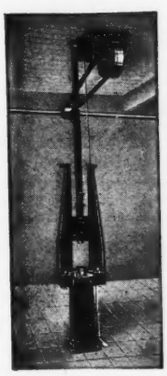
It punches holes 1⅜" x 1", and shears 1" plate. There are provisions for coping tools.

Frames guaranteed unbreakable forever. Popular 48 size with 36" throat illustrated.

The shear end can be changed into a punch end with architectural jaws. Bronze bushings and machine cut gears used throughout. Made in seven sizes with any depth throat desired.

These machines are part of a complete line of punches, shears, bar-cutters, benders, riveters, coping machines and universal machines.

Buffalo Forge Company
144 Mortimer Street
Buffalo, N. Y., U. S. A.



"PECK"

Automatic Drop Lifters

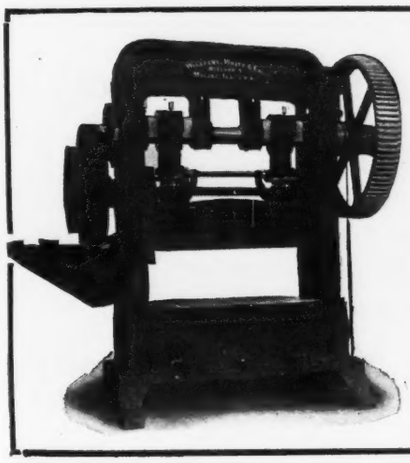
will convert those hand or foot drops and unsatisfactory automatics into

PRODUCTIVE AUTOMATIC DROPS

Capacity 15 to 5000 pounds

DROP PRESSES for all purposes

MINER & PECK MFG. CO.
DERBY, CONN.



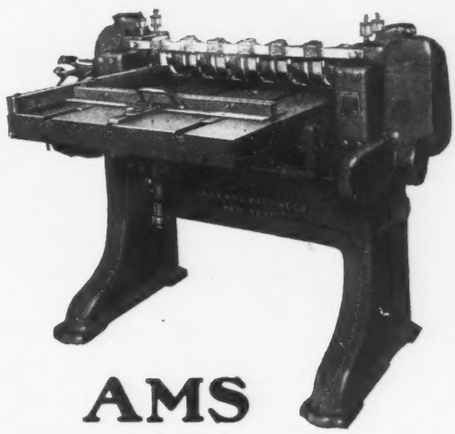
Tie Rod Presses

A Complete Range of Sizes

Manufactured By

WILLIAMS, WHITE & COMPANY
Moline, Illinois

Offices:
Chicago Pittsburgh
Detroit New York



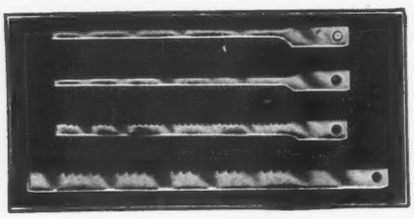
AMS

Gang Slitters for All Light Sheet Metals

High Speed—Labor Saving. Will trim or slit Dead True. Automatic or hand feed. Double edged cutters give double service and can be ground without removing from machine. AMS quick adjustable hub clamp and many other exclusive features make it the most satisfactory machine of its kind. Write for Catalog and complete details.

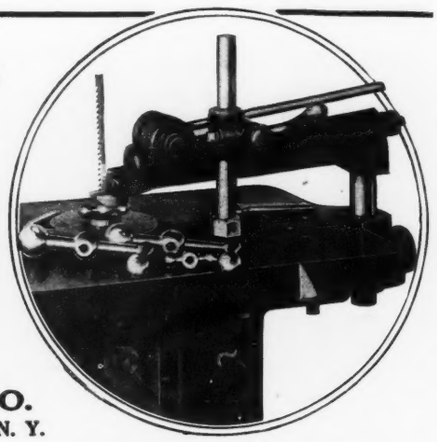
The Max Ams Machine Co.
101 Park Ave., New York
Branches: Chicago, Ill., and London, Eng.

Cutters for Davis Keyseaters



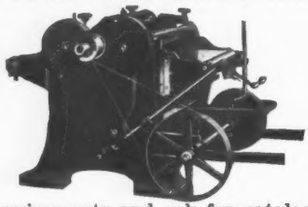
"Headquarters for Genuine Davis Cutters"

Correct steels (Special Broach Steels, High Speed Steels, etc.), accurately cut teeth, the best heat treating and hardening methods—tools that enable these efficient machines to operate most profitably. Stock sizes ready to deliver; quick deliveries on special lengths or cutters for special purposes. Send for price list. Send sketches for estimate on special tools.



DAVIS KEYSEATER CO.
255 Mill Street Rochester, N. Y.

Crescent Wood Working Machinery



is popular because the machines are durable and always please our customers. The time will come when you will need additional equipment to help you speed up production so you had better get a little ahead of your requirements and ask for catalog today describing band saws, jointers, saw tables, planers, planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood workers, hollow chisel mortisers, universal wood workers, table cut-off saw.

THE CRESCENT MACHINE CO.
56 MAIN STREET LEETONIA, OHIO

Cut Cost of Cutting Lubricants

Reclaim cutting oil from metal chips and turnings—mix it with new oil and reuse it time after time.

Let us tell you how manufacturers are saving hundreds and thousands of dollars each year with

TOLHURST CHIP WRINGERS

Write for Complete Information

TOLHURST MACHINE WORKS
TROY, N. Y.

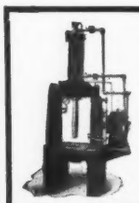
The Skill is All in the Machine

ROTARY SWAGING is the modern and economical method of forming solid or tubular circular metal sections without waste of stock. The Langelier Swaging Machine reduces or tapers to a circular section, square, round, hexagonal, or similar shapes, hot or cold. We build special swaging equipment for Tungsten Filament Wire.

Our policy is to equip the machines in every detail with work holding and feeding devices that will enable them to give the most efficient service with unskilled help at a low upkeep cost.

Machines built to date have capacity ranging from a pin point to 2½" diameter on solid stock, and to 6" on tubing.

LANGELIER MFG. COMPANY
Arlington, Cranston, R. I., U. S. A.



OILGEAR

Hydraulic Presses

For assembling, forcing, straightening and broaching or other work where pressing action is required. Ram responds instantly and smoothly to movement of single control lever. No accumulator required. Bulletin No. 30 on request.

THE OILGEAR COMPANY
398 38th Street, Milwaukee, Wis.

The Principle of Force

As exemplified in hand power is so gathered and arranged in the construction of our line of

HERCULES SHEARS and ROD CUTTERS
PLAIN OR COMBINATION

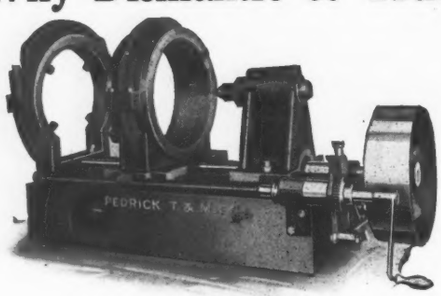
that with minimum of effort you obtain maximum of strength.

Nos. 1, 2 and 5

W. M. & C. F. TUCKER, Hartford, Conn.

Nos. 3 and 4

Why Dismantle to True, Turn, Rebore Heavy Machinery?



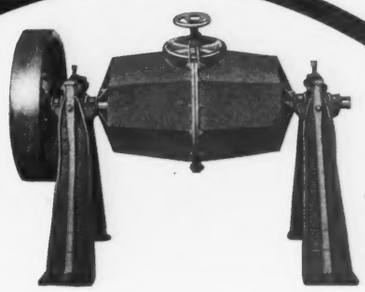
The Pedrick Portable Turning Machine goes to the job—all set. Turns shafts, axles, rolls; trues crank pins; rebores crank pin holes, etc. Accurate. Quick. Convenient. A great time saver. Several sizes to meet all requirements.

Write for details

Pedrick Tool & Machine Company
3639 N. Lawrence St. PHILADELPHIA

Manufacturers of Portable Boring, Milling and Pipe Bending Machinery and Floor Boring Machines

GLOBE TUMBLING BARRELS



TUMBLING is no longer considered the simple operation it once was. A new technology has been created by Globe engineers—and is being added to every day.

The Tumbling Book is a practical summary of new ideas in tumbling.

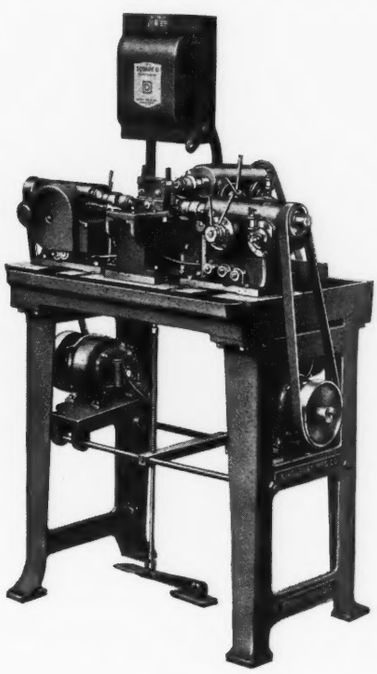
And as it is free, there is no reason at all for not asking for it.

Globules of Wisdom

Progress, like poker playing, is largely a matter of knowing what to discard.

The Globe Machine & Stamping Co.
1255 West 76th St.
Cleveland

Can You Match This Drilling Speed?



This machine, equipped with three spindles, each part of a Kingsbury Automatic Sensitive Drill Head, is drilling three holes at once in cast iron. Each Kingsbury Automatic head adapts itself to the varying hardness of the casting with the precision of a highly skilled operator.

The production of each spindle will average two or three times that of a spindle with a positive worm or cam feed, materially reducing manufacturing costs.

We have produced many machines for high speed small drilling work and our drill head is used extensively by many of the country's best manufacturers. Send us your problem.

KINGSBURY MANUFACTURING CO., KEENE, N. H.

Manufacturers of the

KINGSBURY
AUTOMATIC SENSITIVE
DRILL HEAD

Specialists in full and semi-automatic drilling machinery

REPRESENTATIVES:
Swind Machinery Company, Philadelphia
Purinton & Smith, Hartford, Conn.
Russell, Holbrook & Henderson, Inc., New York, N. Y.
Neff, Kohlbusch & Bissell, Inc. Chicago, Ill.

Two New Machinery Books

For Draftsmen, Machinists, Toolmakers and Shop Executives

The illustration shows one of the new MACHINERY books—"Draftsman's Mathematical Manual." There is another, "Machinists' and Toolmakers' Manual," twin brother to the book shown—same size, 4½" x 7"—same binding, flexible black Atholeather. Just right to carry in your pocket. Paper, dull finish and adapted for reading under every possible condition.

These new books are published in response to a demand for handy, complete and useful guide books covering the thousand and one essentials of the art of the draftsman, machinist and toolmaker.

Look the books over, we send them on approval, and satisfy yourself that they are the handiest little volumes you have met up with in a long time. Coupon saves the trouble of writing a letter.

THE INDUSTRIAL PRESS, Publishers of MACHINERY,
140-148 Lafayette St., New York, N. Y.

Send me on approval, MACHINERY'S new books:

[ ] DRAFTSMAN'S MATHEMATICAL MANUAL
[ ] MACHINISTS' AND TOOLMAKERS' MANUAL

Price $2.00 each.
(If you want to see only one —cross out title not wanted.)

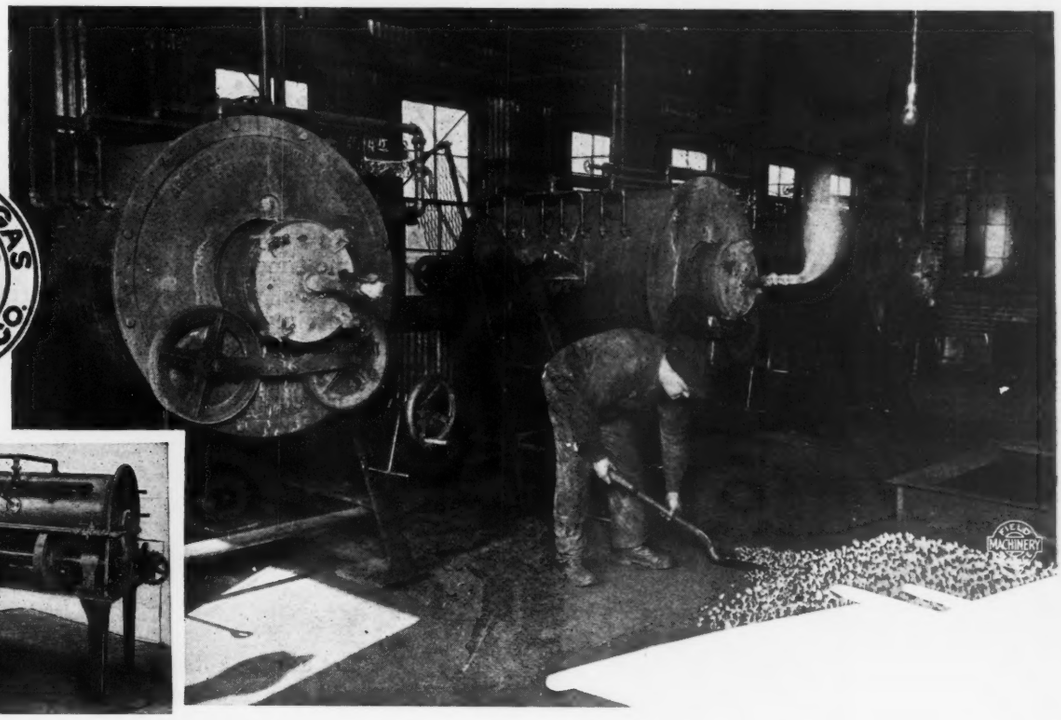
It is understood that I am to have the privilege of return within five days if not satisfied.

Name.....

Address ..... *City* .....

Position ..... *Firm* .....

FOREIGN PURCHASERS—Send remittance with order; add fifteen cents per book for postage.



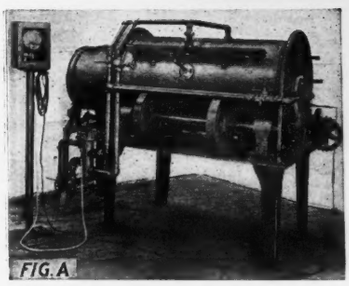


FIG. A

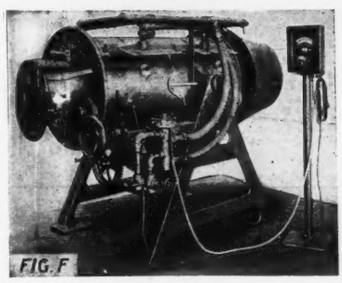


FIG. F

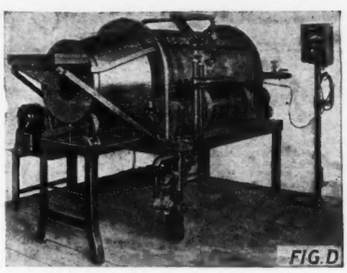


FIG. D

In carbonizing with "Rotaries" the retort revolves automatically and slowly tumbles the work inside, through which gases pass, permeating every exposed surface and carbonizing to a uniform depth in a quarter of the time which would be required by the old method of charcoal and bone packing.

Let us treat samples of your work—identical results guaranteed with American equipment.

"A Good Thing"

—and they know it

Ever come across a man who was making money and try to draw him out about his methods? Close mouthed? You bet!

The above photo is of a battery of American Gas Furnaces—"Rotaries"—in the shop of a very well-known chain company;—we tried to get this company to give us facts and figures about their production but it didn't work. They consider themselves fortunate in having such a profitable outfit and prefer to believe that their competitors are not wise to it. This battery consists of five 2 B Carbonizing Machines.

American Gas Furnaces put heat-treating in the class with other high production operations. There's no guesswork—American machines heat-treat on a high production basis as economically as a good die stamps out parts.

The American line consists of many known types of furnace for every conceivable heat-treating requirement. Almost half a century of manufacture of these machines makes heat-treating and American Furnaces almost synonymous.

AMERICAN GAS FURNACE COMPANY

Main Office and Works

ELIZABETH, NEW JERSEY

Cut Power Costs—
Increase Welding Production

ELECTRIC THOMSON WELDING

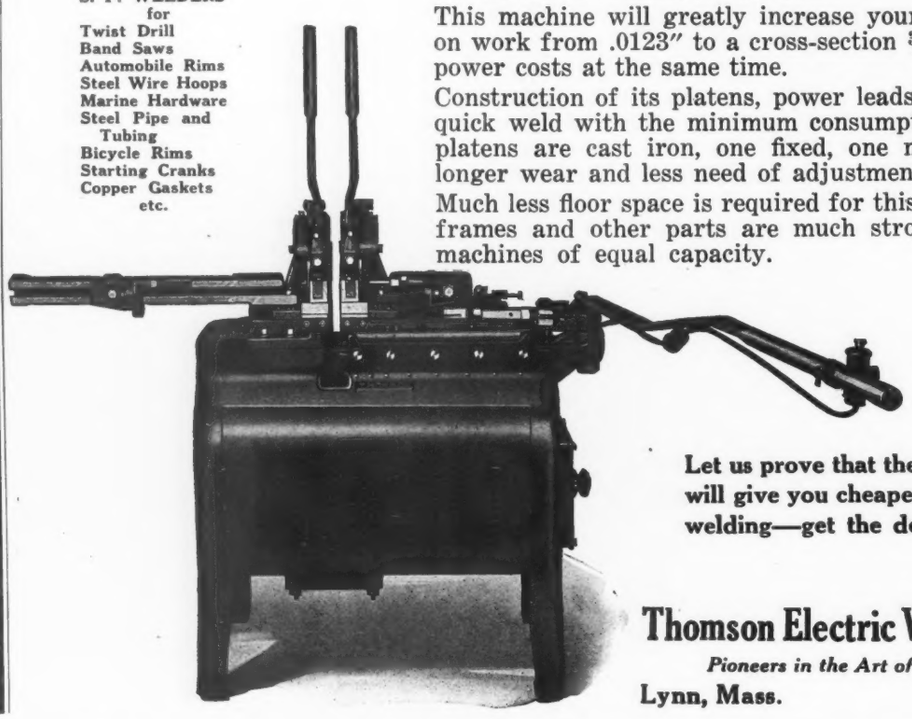
USE
S. P. WELDERS
for
Twist Drill
Band Saws
Automobile Rims
Steel Wire Hoops
Marine Hardware
Steel Pipe and Tubing
Bicycle Rims
Starting Cranks
Copper Gaskets
etc.

It will be to your advantage to get all the details of this New Thomson 6 S. P. Butt Welder.

This machine will greatly increase your welding production on work from .0123″ to a cross-section ¾ of an inch and cut power costs at the same time.

Construction of its platens, power leads, etc., provides for a quick weld with the minimum consumption of power. Both platens are cast iron, one fixed, one movable—making for longer wear and less need of adjustment.

Much less floor space is required for this machine, though the frames and other parts are much stronger than our older machines of equal capacity.



Let us prove that the new S. P. Welder will give you cheaper, faster and better welding—get the details.

Thomson Electric Welding Company

Pioneers in the Art of Resistance Welding

Lynn, Mass. **Cincinnati, Ohio**

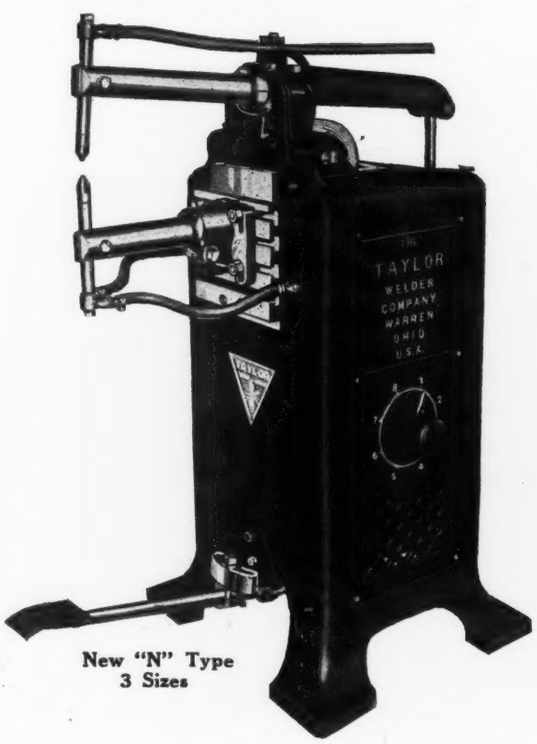
TAYLOR SPOT WELDS

Introducing
the new "N"-type
TAYLOR SPOT WELDERS

Designed specifically for the hard and steady service to which welding machines today are subjected, these new "N" Type TAYLOR Spot Welders will meet the needs of continuous duty and the severest strains of everyday service with practically no wear or tear.

At every point they have been specially reinforced, parts have been reduced to a minimum, wearing points kept down to the lowest number and accessibility and convenience considered throughout their design.

We confidently believe this new series "N" to be the foremost spot welder of its type yet introduced for continuous volume production.



New "N" Type
3 Sizes

Latest, Most Advanced and Exclusive Features

Water-cooled Transformer *Automatic Switch* *Adjustable Foot Treadle*
Quick-change adjustable stop controlling travel of upper electrode
Handy built-in tool box *One-piece, rugged base*
New design horn-raising lever, upper horn adjustable

HTN-1

Write for special illustrated "N" Type folder on press!

The TAYLOR WELDER CO., Warren, Ohio

Federal

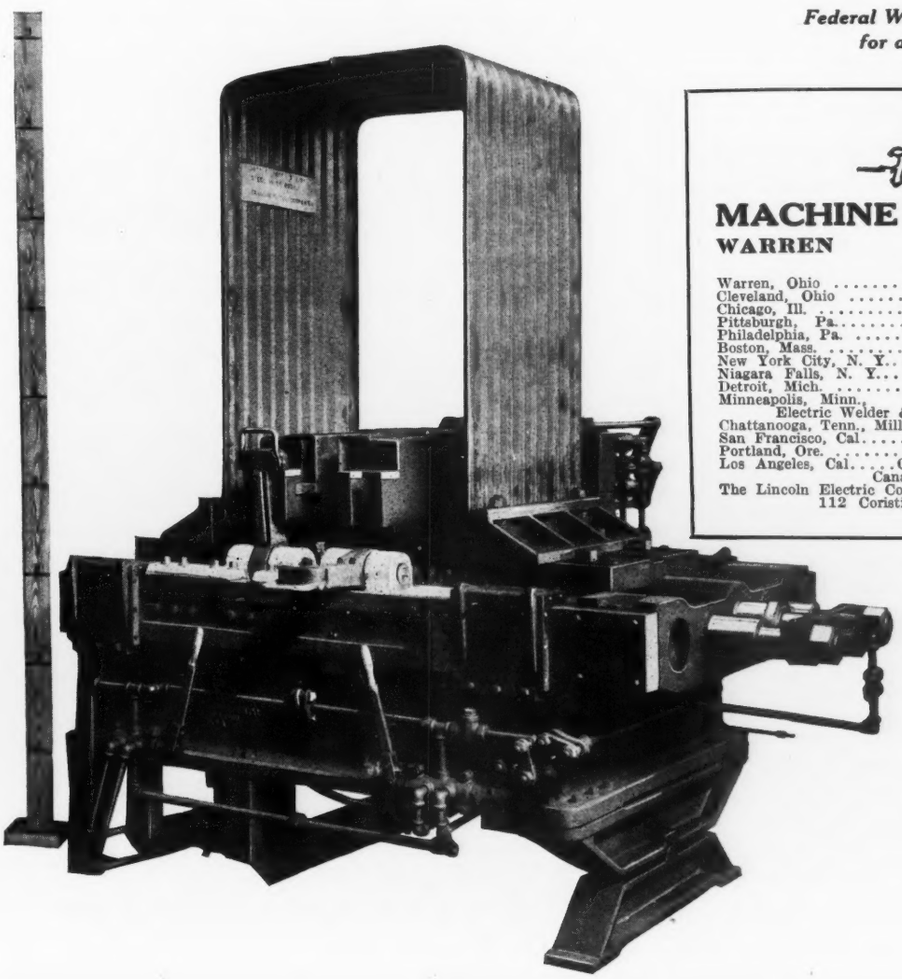
Important Changes for Greater Efficiency in Welding Big Work

This Heavy Duty Federal Butt Welder (capacity to ½" thick, 30" wide) operates from a hydraulic accumulator system of 1000 to 1200 pounds pressure and is capable of a pressure of 40 tons in completing a weld. Hydraulic pressure also provides the force by which the heavy steel racks and pinions operate the eccentrics which clamp the work with a pressure of 35 tons on each holding jaw.

One of the most valuable new features of this machine is the change in the construction of the movable slide. This is carried on steel bars extending the full length of the machine—bearings at the extreme ends of the bars give a bearing 6 feet in length (instead of the usual two feet), making the machine extremely rigid under the strains of heavy pressure.

Changes in the design of a Federal Welder mean that experience has taught us how to make the machine more efficient.

Federal Welders are built in sizes for all classes of work



The Federal

MACHINE & WELDER CO.

WARREN OHIO, U. S. A.

OFFICES AT

Warren, Ohio ..... Dana Avenue
Cleveland, Ohio ..... 947 Leader News Building
Chicago, Ill. ..... 15 South Clinton Street
Pittsburgh, Pa. ..... 932 Oliver Building
Philadelphia, Pa. ..... W. S. Green, Section "W" Bourse Bldg.
Boston, Mass. ..... 126 State Street
New York City, N. Y. ..... 17 Battery Place
Niagara Falls, N. Y. ..... 311 Falls Street
Detroit, Mich. ..... 3-233 General Motors Bldg.
Minneapolis, Minn.,
Electric Welder & Specialty Co., Builders' Exchange Bldg.
Chattanooga, Tenn., Mills & Lupton Supply Co., 1146 Market St.
San Francisco, Cal. ..... Coast Equipment Co., 85 Columbia Sq.
Portland, Ore. ..... Coast Equipment Co., 309 Lewis Bldg.
Los Angeles, Cal. ..... Coast Equipment Co., 301 Roberts Bldg.
Canadian Representatives:
The Lincoln Electric Co. ..... 136 John St., Toronto, Ontario
112 Coristine Bldg., Montreal, Canada

Ask about the new Federal Flash-proof Transformer on our latest machines

WE DO COMMERCIAL HEAT-TREATING

including—

CASE-HARDENING
HARDENING
ANNEALING
TEMPERING
GUN METAL
COLORING, ETC.

AMERICAN METAL TREATMENT CO. Spring and Lafayette Streets ELIZABETH, N. J.

A Time Study Necessity

Coats Hand Tachometers

furnish revolutions per minute and feet per minute.

without

watch-timing or calculating. Operate both right and left-hand.

Seven types, from 30 to 24,000 r.p.m.

Hand Tachometer (½ actual size) 4-Speed type, 30 to 4000 R.P.M.

COATS MACHINE TOOL COMPANY, INC.
112 West 40th Street NEW YORK, N. Y.

S C & H
Industrial Furnaces and Furnace Room Accessories
THE STRONG, CARLISLE & HAMMOND CO.
CLEVELAND OHIO

"HEAT-EASY"

A compound used in hardening HIGH SPEED STEEL.
Prevents Scaling and Distortion. Gives Wonderful Results. Once Tried is Always Used.
Made and sold exclusively by
THE BENNETT METAL TREATING COMPANY, Elmwood, Conn.

Means that we make Arc-Spot-Butt-Seam-Automatic Welders.
Means that our engineers are located in New York, Philadelphia, Cleveland, Cincinnati, Detroit, Chicago, Los Angeles.
GIBB INSTRUMENT COMPANY
Bay City *Manufacturers* Michigan

WHEREVER HEAT IS USED IN INDUSTRY
gas **FURNACES** oil
UNIFORM TEMPERATURE—MAXIMUM OUTPUT—MINIMUM FUEL COST.
363 GERARD AVE. BRONX, N.Y. NEW YORK
THE SURFACE COMBUSTION CO.
PHILADELPHIA PITTSBURGH CHICAGO BALTIMORE

Solve the Electrode Heating Problem with the "Taperod" Welding Electrode

As the length of an electrode decreases, the heat of the arc increases. Every welder must contend with that—and therefore will welcome enthusiastically the "Taperod," the welding electrode that keeps the heat constant from start to finish. Progressive heating of rod is banished also.

How is it done? The "Taperod" is tapered, that's all; thicker at the holder end, so that as the intensity of the arc increases, there is an equal increase in metal to compensate for it. Instead of burning away to a cinder while yet many inches long, the Taperod deposits more metal on the weld and is used up, not thrown away. (Question: What proportion of your *straight* welding rods are used to the last available inch?)

The small diameter at the tip means a quick heat and an easy start, particularly in narrow cuts and reentrant spaces.

Interested? We are now making immediate deliveries—at the same prices you are paying for straight welding rods. *Write for details.*

THE ELECTRIC ARC CUTTING & WELDING COMPANY
152 JELIFF AVENUE, NEWARK, N. J., U. S. A.

Luma

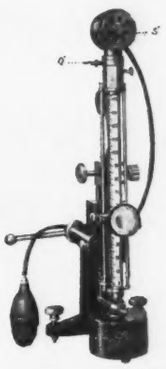
Weighs 20 Pounds—Has a Hundred Uses!

Complete equipment for demagnetizing, etching, annealing and soldering, in compact, convenient form. Pass tools that have become magnetized longitudinally over the top and free them instantly; use the point to mark your work, to solder, to anneal. Plug in on any A.C. lighting circuit and you're ready for work.

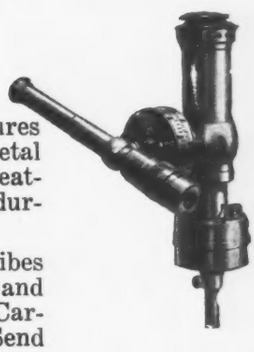
A well made, practical, profitable machine—send for a circular

Luma Electric Equipment Company
Post Office Box No. 132 Main Office
TOLEDO, OHIO

Your Products Bring No "Come-backs"



By the use of the SCLEROSCOPE you can prevent inferior metal from entering into your products, every piece you turn out will be perfect-proof against all come-backs. The Scleroscope reveals the quality of the metal by measuring its hardness.



The PYROSCOPE measures the temperature of the metal in the process of heat-treatment. Simple to operate, durable and fool-proof.

The Shore Booklet describes both instruments in detail and also the Shore Process of Carbonizing and Hardening. Send for it.

The Shore Instrument & Mfg. Co.
Van Wyck Ave. and Carll St., JAMAICA, NEW YORK
FOREIGN AGENTS: Agent for Great Britain and Colonies, Coats Machine Tool Co., Ltd., 14 Palmer St., Westminster, London, S. W. Yamatake & Co., Tokyo, Japan. Aux Forges de Vulcain, Paris, France. R. S. Stokvis & Zonen, Ltd., Belgium and Holland.

DAVIS-BOURNONVILLE COMPANY
was merged with
AIR REDUCTION SALES COMPANY
on March 17, 1922

The Oxy-acetylene Welding and Cutting Products formerly manufactured by Davis-Bournonville Co., are now made and sold by Air Reduction Sales Co., under the trade name of "Airco-Davis-Bournonville" or "Airco-D-B."

(See Advertisement of Air Reduction Sales Co.)

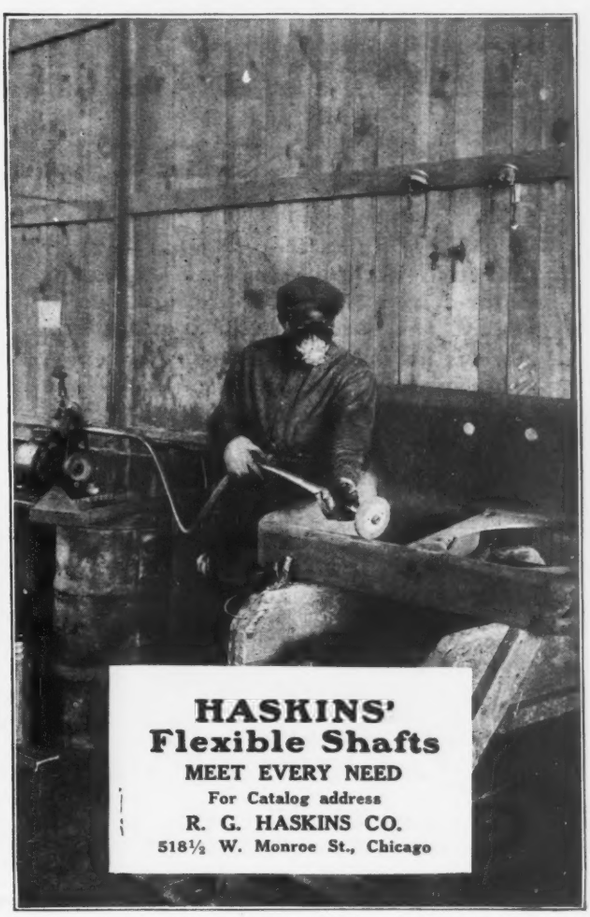
THE ACME SPOT WELDER

Low in Price — Carried in Stock
High in Efficiency — Shipped F.O.B. Phila.

ACME ELECTRIC WELDER CO.
LOS ANGELES, CAL.
PHILADELPHIA Bourse Bldg Section S — CHICAGO, 538 W. 25th Street

KASENIT

Non-poisonous—Non-Explosive—Non-Inflammable
Open Fire Case Hardening Compound
Booklet on Modern Methods of case-hardening sent free on request
KASENIT CO., Div. 3, 2 and 4 Stone St., New York



HASKINS' Flexible Shafts
MEET EVERY NEED
For Catalog address
R. G. HASKINS CO.
518½ W. Monroe St., Chicago

Write for Catalog

WINFIELD BUTT WELDERS

were the pioneer flash-proof type. On many models hardened steel plates are optional, on others standard equipment, this construction preventing any fine particles of metal from coming in contact with bearings, etc.

THE WINFIELD ELECTRIC WELDING MACHINE CO., WARREN, O.

Purchase Your Oxygen Under Specifications both for Quality and Quantity

AIR REDUCTION SALES COMPANY prefers to sell you on this basis

AIRCO
DAVIS BOURNONVILLE

Air Reduction Sales Company

Home Office: 342 Madison Avenue, New York City

26 Airco Oxygen Plants
16 Airco District Offices
12 Airco Acetylene Plants
14 Airco Repair Stations
2 Airco Calorene Plants
72 Airco Distributing Points

Airco Apparatus Factories and Laboratories at Jersey City and Elizabethport, N. J.

ANYTHING and EVERYTHING for OXYACETYLENE WELDING and CUTTING

Copyright, 1924, Air Reduction Sales Co.

Thorn Portable Demagnetizer

A thoroughly efficient demagnetizer that will do anything the expensive motor-driven types will do, and do it faster. The purchase cost is much less, there is no installation cost; and operation and maintenance charges are negligible.

Weighs only 13 pounds—nothing to get out of order—take it to any part of the shop and plug in on any lamp socket. Every small shop can afford one. Every large shop needs a Thorn Demagnetizer to supplement its big stationary outfits.

Specify voltage (110 or 220) and we'll send you one. Money refunded if you are not entirely satisfied.

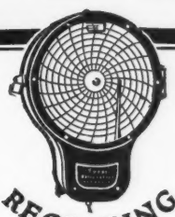
$30 Buys It—

and it pays for itself in no time!

A. J. LITTLEJOHN
General Distributor
508 East Genesee Street SYRACUSE, N. Y.

THORN

Tycos temperature instruments



Oil Tempering Baths

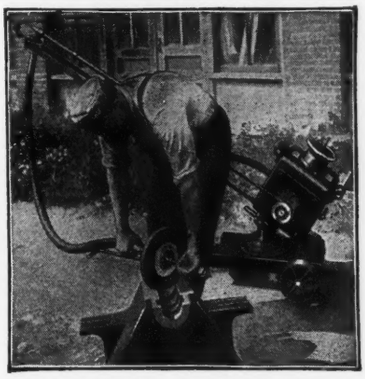
This is the *Tycos* Thermometer to use for Oil tempering baths. (No. 798.)

Suitable catalogs sent. Mention your temperature processes.

Taylor Instrument Companies 318

Rochester, N.Y., U.S.A.

There's a *Tycos* and *Taylor* temperature instrument for every purpose.



STOW Portable Grinder

All sizes, all currents.

For Abrasive wheel, wire scratch brush, and similar applications.

Indispensable for grinding and similar work, built only by the

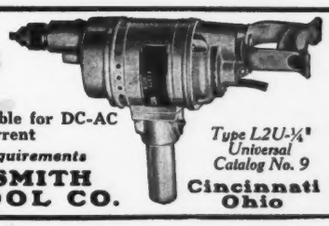
STOW MANUFACTURING CO., Inc., Binghamton, N.Y.
London Stock: 85 Queen Victoria Street

PORTABLE ELECTRIC DRILLS and GRINDERS

Complete line of sizes suitable for DC-AC and Universal Current

Tested to U. S. Navy requirements

THE NEIL & SMITH ELECTRIC TOOL CO.



Type L2U-¼" Universal Catalog No. 9

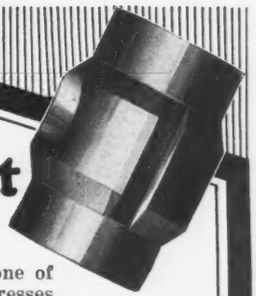
Cincinnati Ohio

Improved Marking Devices

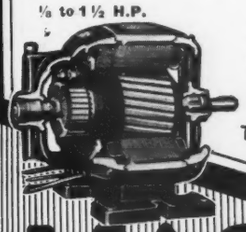
Consider our factory your experimental laboratory.
Our knowledge of methods of marking on metal parts may be valuable to you.
We make the machines, also the marking dies.

The Noble & Westbrook Mfg. Co. 19 Asylum Street Hartford, Connecticut

True Alignment -Always-



IN testing our motors, one of the features which impresses engineers is the Master Self-Aligning Bearings. Due to their patented design, they are *always* in true alignment—no chance for anything else. Bearing adjustments are unnecessary. The shaft operates with minimum friction. Perfect air gaps are maintained. ¶This is only one of many important features which are built into Master Motors—which are responsible for continuous, uninterrupted service year after year.



⅛ to 1½ H.P.

If you buy motors or design electrically driven appliances, it will pay you to investigate. Write for full details—motors sent for test to reliable manufacturers.

The Master Electric Co.
448 First St., Dayton, Ohio

MASTER 40°C MOTORS 40°C

CROCKER-WHEELER

PIONEER MOTOR MANUFACTURERS
Established 1888

May 17, 1860
A milestone in electrical history

1860—a year of great moment for the world and industry: Planté—and the lead storage battery; Reis—and the telephone.

And on May 17, 1860, Schuyler Skaats Wheeler was born—engineer, manufacturer, author, inventor. To the brilliant mind and almost tireless energy of this electrical pioneer, can be traced a score of outstanding developments.

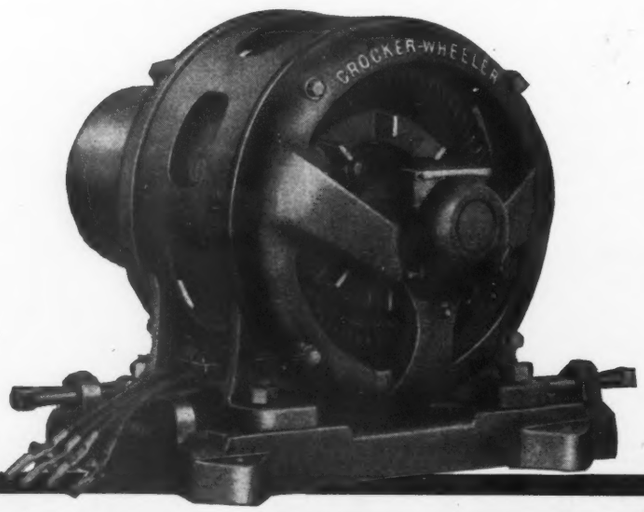
Among the many inventions of Dr. Wheeler may be named the electric fire engine, series-multiple motor control, and the paralleling of dynamos. In 1904, he received the John Scott medal of the Franklin Institute for inventing the electric fan.

For the important role it has played in the electric motor industry, the Crocker-Wheeler Company is immeasurably indebted to the genius of this remarkable man,—one of its founders and, until his death on April 20, 1923, its president.

CROCKER-WHEELER COMPANY, AMPERE, N. J.

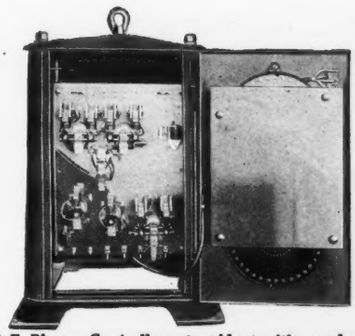
BALTIMORE	BUFFALO	DETROIT	PHILADELPHIA
BIRMINGHAM	CHICAGO	NEW HAVEN	PITTSBURGH
BOSTON	CLEVELAND	NEW YORK	SAN FRANCISCO

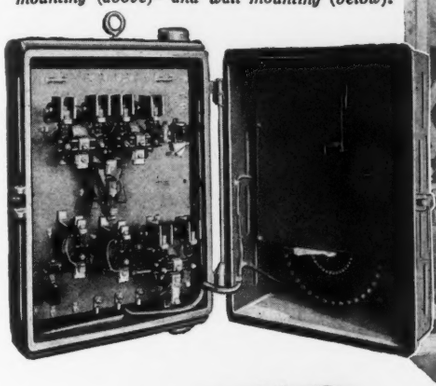
Foreign Distributor: International Western Electric Co.



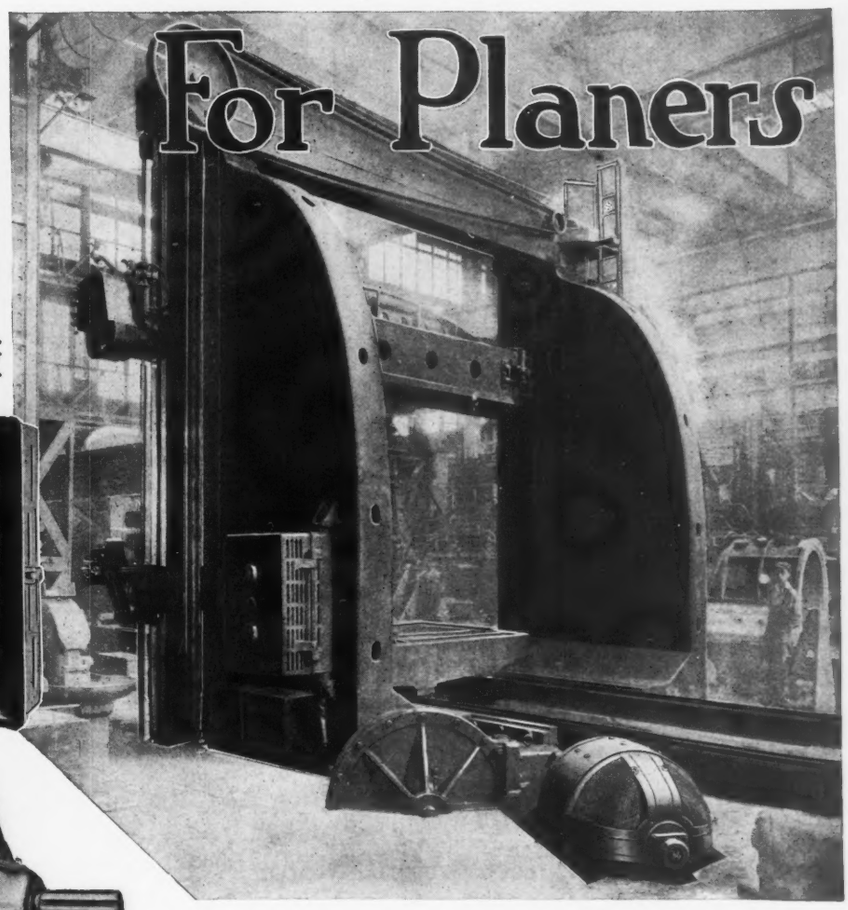
CROCKER-WHEELER COMPANY TRADE MARK

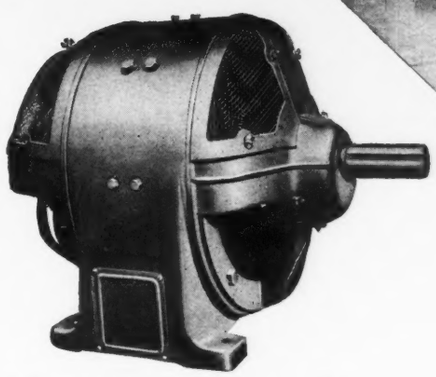
MOTORS & GENERATORS





G-E Planer Controllers provide positive under-voltage and overload protection. Types for floor mounting (above)—and wall mounting (below).





G-E Type RF Direct-current Reversing Motor drive—the most highly developed drive for large planers. Over 2000 are in this service.

Dynamic Braking

with Reversing Motor equipment has these advantages

—Positive slow speed and definite stop for setting up work, without extra equipment.

—Requires less control apparatus, which lowers maintenance cost.

—Simple to operate. To bring planer to rest, throw master-switch to off-position and platen stops within definite over-travel.

—Accurate stopping, for operating current is independent of line current.

—Dynamic Braking prevents platen running off bed should line contactor remain closed from any cause.

Ask the nearest G-E Sales office for complete information on this equipment. It has many advantages over the plugging method.

When the *complete* electric equipment is built by *one* manufacturer—you get service that satisfies.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

43B-853

GENERAL ELECTRIC

THE MONITOR SYSTEM

The Original "Just Press a Button" System

THE Monitor System is a result of continuous development work on the part of its Engineering Staff over a period of 36 years. We chronicle below the beginning of the art and the first use of each salient principle in motor starters, all the work of the Monitor Company's Engineering Staff.

1888

First Automatic Direct-current Motor Starter.

1889

First Solenoid-operated Automatic Motor Starter.

1890

First Automatic Starter with Clock Escapement for Direct-current Motors.

1893

First Belt-driven Type Automatic Motor Starter.

1905

First Current-limit Type Automatic Motor Starter.

1906

First Preset-speed Automatic Motor Control for DC Motors.

1912

First Preset-speed Automatic AC Motor Control giving Full Torque Start.

1919

The Thermaload Starter for AC Motors.

The original standardized unit system of construction permits the Monitor Controller Company to produce *from standardized parts* controllers to meet all conditions.

The advantages of Monitor Automatic Machine Tool Control are given in Bulletin 1006.

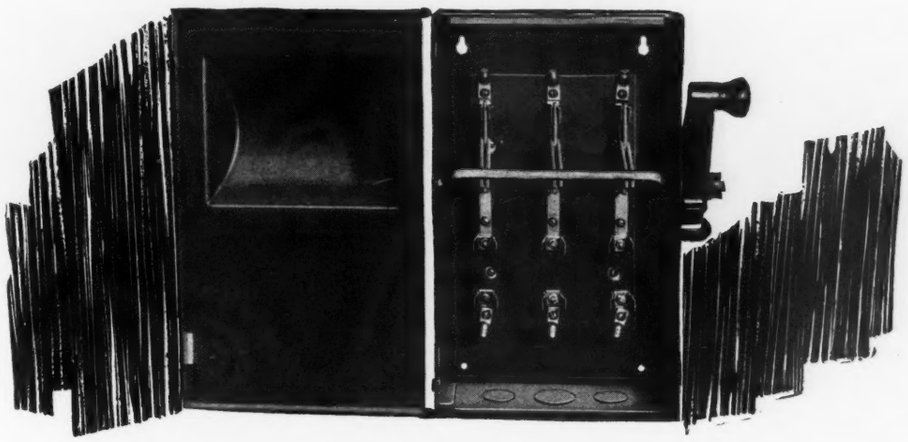
New York
Cleveland
Chicago
Boston
Buffalo
Philadelphia

Cincinnati
St. Louis
Detroit
Birmingham
Pittsburgh
New Orleans

Monitor Controller Company

BALTIMORE, MARYLAND

5920-1



Announcing—A New Line of Safety Enclosed Switches

Type WK-60

Insistent demands from industrial engineers in all parts of the country for a moderately-priced safety industrial switch have resulted in the development and perfection of the new Tyye WK-60. It has no equal in its class, anywhere, combining as it does, highest quality construction with superior mechanical features and economy. Operating tests under conditions far more severe than these switches will encounter in actual service prove that this line is now perfected.

The quick-make and quick-break mechanism is very unique in that it is extremely simple as well as highly dependable and is entirely contained in the switch handle. This entire mechanism can be removed without disturbing any other parts of the switch.

Furnished in 2-, 3- and 4-pole, 250 and 500 volts—in 30-, 60-, 100- and 200-ampere capacity. Examined, listed and labeled under direction of Underwriters' Laboratories.

Full details on request. Ask for folder No. 4604.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the
United States and Foreign Countries

A Few WK-60 Features

Sturdy construction throughout.

Switch jaws and blades so designed that in disrupting the arc, no current-carrying surface is burned.

No cross bar is used—switch blades are actuated from the crank shaft individually, permitting independent alignment.

Simplicity of operating mechanism.

The mechanism itself is so designed that when opening or closing it has a cushion effect with an ultimate limit of travel—a big reduction of wear and tear on blades and jaws, since no blocks or stops are used.

Operating mechanism easily removable without disturbing switch; and parts subject to wear easily replaceable.

Entire operating mechanism contained in handle outside of box, thus avoiding possibility of loose parts coming in contact with live parts of the switch.

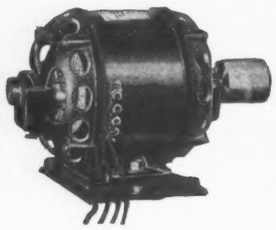
W
WESTINGHOUSE ELECTRIC

Westinghouse

Century

Repulsion Start-Induction

Single Phase Motors



Illustrating the ¼ H.P. Motor

They Keep-a-Running

One-eighth to 40 Horse Power

are so constructed that the brushes touch the commutator only during the period of starting. This is an important factor when you consider that in many classes of service this means that the brushes are only in contact with the armature about 1/900 as long as if they rode the commutator all the time. Years of service without renewals and quiet operation is the natural result.

Century Electric Company

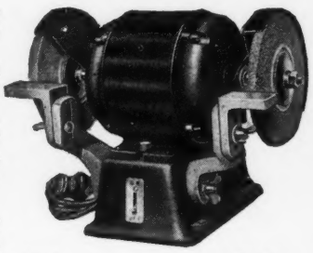
General Offices, 1827 Pine Street
St. Louis, Mo., U. S. A.

SALES OFFICES AND STOCKS IN PRINCIPAL CITIES

MarathoN OK ServicE

A Two Year Free Service Guarantee Back of Every "Marathon OK" Motor

GRINDERS



Pedestal or bench type, with Marathon OK guaranteed type "NU" enclosed dustproof motors. ¼, ½ and 1 h.p. sizes—only practical and safe on-and-off switch on any grinder.

MOTORS **for shop and household use.**

⅛, 1/6, ¼ and 1/3 h.p.—A.C. and D.C. Choice of Binding Post or cord and plug terminals.

Price 25% to 50% lower than others ask, and Marathon OK Motors are better.

Send for descriptive circulars. Mention supply house through which you prefer to buy.

Marathon Electric Mfg. Company

34 Island Avenue WAUSAU, WIS., U. S. A.

WINNERS
of U. S. Electrical Tool Co.
PRIZE CONTEST!

1st—J. J. GRAF, 37 Ash St., Ludlow, Ky.

2nd—HARRY GIBLER, De Beque, Colo.

3rd—LEON PELLET, 2808 Swiss Ave., Dallas, Texas

TIE FOR 3rd—CLAUDE H. ERVIN, Ervin's Electrical Co., Parsons, Kansas

"The Good Mechanic Knows!"

Here is J. J. Graf, winner of first prize. The new Handbook tells of the unusual jobs he does with a portable electric drill.

GET THIS HANDBOOK

Contains many valuable suggested uses for portable electric drills, sent in by good mechanics everywhere. Now being printed. Sent FREE! Get your name in now. Send post card.

The UNITED STATES ELECTRICAL TOOL CO
CINCINNATI, OHIO.

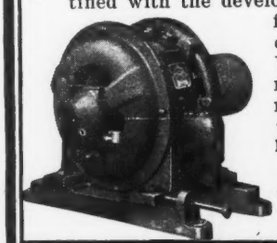
District Sales Offices and Service Stations:

Boston, Buffalo, Chicago, Cleveland, Columbus, Detroit, Houston, Indianapolis, Kansas City, Milwaukee, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, Toledo

Complete stocks carried in all Service Stations

DRILLS VALVE GRINDERS — TIRE PUMPS BENCH GRINDERS

Reliance Engineers have been actively identified with the development of motor drives for machine tools for over eighteen years. You are invited to make use of this experience.



We build both A.C. and D.C. motors.

RELIANCE ELECTRIC & ENGINEERING CO.
1056 Ivanhoe Road Cleveland, O.
Branches in Principal Cities

Type A.A. RELIANCE Induction Motors

Strand

FLEXIBLE SHAFTS AND EQUIPMENTS

Manufactured in Sizes 1/10 to 2 H.P.

For Rotary Filing, Grinding, Drilling, Polishing, Buffing, Screw-Driving, Nut Setting, Etc.

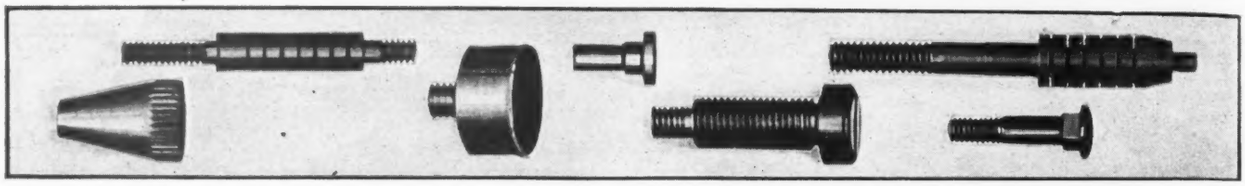
Write for Copy of Our New Catalog

N. A. STRAND & COMPANY

5001 NO. LINCOLN STREET CHICAGO

Special Equipment Section

Special Machinery
Screw Machine Products
Drop Forgings
Fixtures
Tools, Dies, Jigs
Castings
Die Castings
Stampings
Contract Work
and
Designing



Poorman Specializes in Parts Like These

Parts that fit when your assemblers get them. Many years' experience.
Radio parts a specialty.
Screw Machine Products up to 3½" diameter, any metal. Let us estimate.

J. E. POORMAN, 1825 Bristol Street, Philadelphia, Pa.

We Guarantee Results

Whatever the jig, die or fixture, we have the equipment to produce it quickly and perfectly and economically —without wasting our time or your money.

Your work will be handled all along the line, from drafting board to finished product, by a staff of experts who know what they're doing—and do only what they know!

Let us figure with you on your next order.

Reliance Die & Stamping Co.

515 N. LaSalle St., Chicago, Ill., U. S. A.

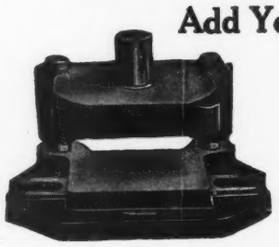
A MODERN, well equipped Boiler, Machine and Blacksmith Shop enables us to build many kinds of special machinery.

Regular line of manufacture includes:

Foundry Cupolas and Ladles
Core Oven and Cars
Tanks and Stacks
Tumbling Barrels
Sand Blast Machinery
Dust Collectors Cloth Screen Type
Overhauling of Steam Shovels and Locomotive Cranes.

J. W. PAXSON COMPANY
Nicetown Lane and D Street PHILADELPHIA, PA.

U. S. SUB PRESSES
Add Years to your Dies



A die in a U. S. Sub Press last five times as long as an open die. That's because U. S. Sub Presses align properly.

They are not only better than home made sub presses, but cost less, shipped direct to you by Parcel Post, than it costs you to make them yourself. Send for price list and be convinced.

U. S. TOOL COMPANY, Inc.
145 Lafayette Street, New York City, N. Y.
117 Mechanic Street, Newark, N. J.
Complete stock at N. Y. C. for immediate delivery. Phone or wire Canal 7775

WICACO
Screw & Machine Works, Inc.
Stenton Ave. and Louden Street PHILADELPHIA Wayne Junction P. & R. R. R.

Established in 1868 = 56 years of continuous production

The most modern factory and equipment in the United States for producing

Screw Machine Parts

all sizes, kinds, quantities, materials, for all purposes

Grinding, Oil Grooving, Thread Milling, Heat Treating, Machine Work of Precision.

TOOLS

Send us your blueprints for estimates

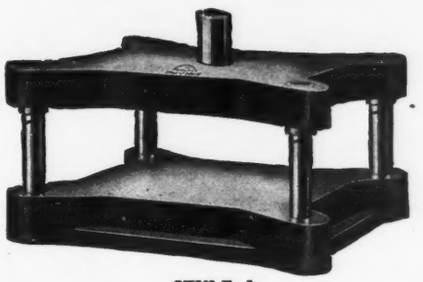
R. W. ORRELL MACHINE CO.
421 Beach Street FLINT, MICH.

JIGS TOOLS DIES

We can give you excellent service, making and designing Dies, Fixtures, Special Machines, Jigs, Small Tools, Gauges and Stampings.

AMERICAN TOOL & MFG. CO.
Urbana, Ohio
A Card will bring our Catalogue

A Key Tool in Your Production Schedule



STYLE J

The making of new dies often requires utmost speed in the production schedule. A delay of days or hours often upsets the manufacturing program. You will never have to call for help—if you use the Danly Standard Die set plant as an adjunct to your own stockroom.

Danly Die Sets are made in every conceivable style and size. Ready to ship on instant notice.

Send for Complete Catalog, Prices and Discounts

DANLY MACHINE SPECIALTIES, INC.
4907 Lincoln Ave., CHICAGO, ILL.

TRADE **MEHL MADE** MARK

HIGH GRADE
JIGS, FIXTURES, DIES, GAGES AND SPECIAL MACHINES
SEND FOR FREE ILLUSTRATED PROSPECTUS
MEHL MACHINE TOOL & DIE CO.
Established 1913
30 Minutes from New York City ROSELLE, NEW JERSEY

LET US BE YOUR TOOL-ROOM
Dies, Tools, Jigs, Gages, Fixtures, Etc.
We have the reputation for producing tools that are foolproof, easy to manipulate and give the largest possible production.
Quality—Prompt Delivery—Fair Price
Arthur Brock, Jr., Tool & Manufacturing Works
533 North 11th Street Philadelphia, Pa., U. S. A.

Do You Want Real Service? **Dies, Tools**
Special Machinery—Small Stampings. Production Work on Machine Parts. Real Service at the Right Price.
With fine equipment and a splendid organization we guarantee satisfaction. Let us quote you on your requirements.
THE BANNER DIE, TOOL & STAMPING COMPANY
COLUMBUS, OHIO

Cost Cutting—

Is there a manufacturing firm in the country that desires to reduce manufacturing costs?

Chorus—They all do!

Is there a manufacturing cost that cannot be reduced?

Answer—There is not—it's just a question of expense and benefits derived.

With these outstanding facts emblazoned on the industrial horizon, it's well worth while for any manufacturing concern, no matter what the line, when considering ways and means to reduce production costs, to consult with

The Columbus Die, Tool and Machine Company

There are some very pertinent reasons why it will be worth while that the company will be glad to explain in detail.

Write us at Columbus, Ohio

Turn Waste into Profit

You may know that there is a loss of one kind or another going on in your shop and you either can't find it or you don't know how to stop it.

Let us find and stop it for you. It's our job to hunt out profit leaks without in any way disturbing routine or interfering with business.

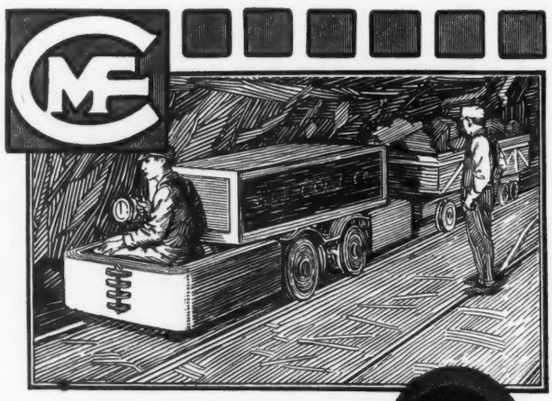
One well-known automobile manufacturer thanks us for saving him 20% to 30% cylinder scrap—thousands of dollars profit saved. Why not you?

O. C. Kavle, L. W. Moulton and Staff of Associate Engineers and Designers—Known as

Manufacturers' Consulting Engineers

McCarthy Building, Syracuse, N. Y.

Production Engineering Consulting and Designing

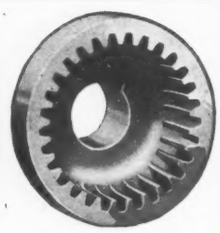


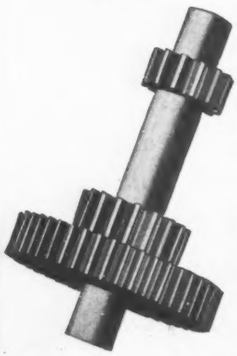
One by one leading manufacturers are using drop forged parts for the load bearing and strain resisting parts of their products. The tough give and take strength of forged steel offers no element of chance breakdowns, but affords reserve stamina for emergency loads and hard pulls.

Sell on the basis of performance and endurance and you'll sell at a profit, even under present day conditions. Write for a Champion Engineer and you'll get help.

THE CHAMPION MACHINE & FORGING CO.
3695 East 78th Street CLEVELAND, OHIO
New York Office, 30 Church St. Philadelphia Office, Bourse Bldg.
Detroit Office, 705 Ford Bldg.

CHAMPION DROP FORGINGS





McGill Metal Die Castings

High Grade Bronze with the Strength of Steel

A special metal die cast by a special process that produces finished parts, accurate within practically any desired specifications and that require no further machining. McGill Castings have the machining qualities and strength of high grade steel, are light in weight, malleable, ductile and non-corrosive.

Physical Properties

Tensile Strength	75,000 lbs.
Compressive strength,	120,000 lbs.
Elongation	18 to 20%
Elastic Limit	30,000 lbs.
Hardness, Scleroscope	20
Hardness, Brinnell	130

Let us estimate on your work

McGILL METAL COMPANY

VALPARAISO INDIANA

OUR ability to handle your machine and mechanical construction in every phase, including engineering, pattern work, machine work, assembly, as well as the foundry work which we can take care of in our own modern iron and steel foundries will appeal to you as it has for thirty years to our many satisfied customers.

Give us a trial

THE ADAMSON MACHINE CO.

AKRON, OHIO, U. S. A.

Du Pont Engineering Company

WILMINGTON SHOPS

WILMINGTON, ——— DELAWARE

Contract Builders of Special Mechanical Equipment and Castings

OUR SPECIALTY

Special Machinery made to your blueprints. Contract work. Metal patterns. W. C. O. cast aluminum machined pattern plates.

Let Us Quote You

DAVENPORT MANUFACTURING CO.
MEADVILLE, PA.

Better Methods
Better Die Castings

Dependable SUPER CAST Die Castings

THE SUPERIOR DIE CASTING CO.
CLEVELAND, OHIO

Specify Alemite Die-Castings
For Strength, Uniformity and Economy

Our large, modern plant, with the latest improvements in die-casting machines and facilities, assures you of a dependable source of supply. Castings made from aluminum, zinc, tin and lead base alloys.

Consult our Engineering Department on your die-casting problems. Your inquiries will receive prompt attention.

Send for Catalog

Alemite Die-Casting & Mfg. Co.
2640-54 Belmont Avenue, Chicago

"Die Casting since SOSS 1908"

EQUIPMENT, DELIVERIES AND PRICES ARE RIGHT

SOSS MANUFACTURING CO.
Grand Ave and Bergen St. Brooklyn, N.Y.

DIE CASTINGS

Prompt delivery guaranteed. Send samples blueprints or sketches for estimates.

MT. VERNON DIE CASTING CORPORATION
MOUNT VERNON, N. Y.

EC

ELECTRIC STEEL CASTINGS

Farrell-Cheek Steel Foundry Co.
SANDUSKY, OHIO

FRANKLIN DIE-CASTINGS

Rigid Checking Keeps Quality Standard High

Exceptionally careful inspection is the final step in the process which has made Franklin a world standard for quality in Die-Castings.

It is in the hands of men whose judgment is based on Franklin's unequalled 32-year experience in what constitutes a perfect die-casting. Trained to recognize essential points, they safeguard the interests of the user every step of the way.

Franklin engineers have been simplifying production problems and reducing production costs ever since 1892, when they originated the industry. Consult us about your product.

We cast in aluminum, tin, lead and zinc base alloys. Quotations on receipt of samples or blue-prints. Write for booklets: "Franklin Die-Castings in Modern Inventions", and "Die-Casting".

FRANKLIN DIE-CASTING CORPORATION
Gifford and Magnolia Streets Syracuse, N. Y.

Franklin Die-Cast Gears

Talk about Forging!

Any shop would feel proud of its achievement in turning out a steel forging like this one. It takes real ability to retain symmetry of the curved and tapered sections in work of this kind. We are proud to say that it's a J & J "Better Forging"—that there will be mighty little finish machining required to bring it to size.

Don't hesitate to give us the worst sticker of a job in your place, when you send us a trial order. We'd like to show you what we can do and the harder the work the more firmly you'll be sold on J & J Forgings.

Get in touch with us

The Johnston & Jennings Co.

Incorporated 1894

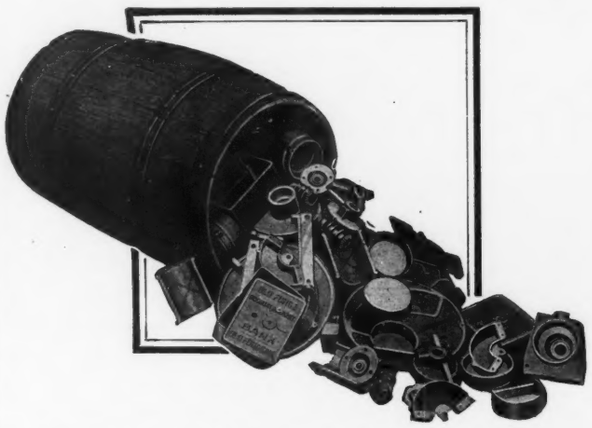
Addison Road and Lake Shore R.R. Tracks

Cleveland Ohio

J & J BETTER FORGINGS

Spindles
Arbors
Axles
Gear Blanks
Engine Shafts
etc.

Here's a Way to Cut Costs



Phoenix Die Castings will help you cut costs because they *eliminate* finish machining, which takes time and labor and requires machines, jigs, fixtures, etc. The Phoenix method of forcing molten metal into the dies under pressure makes dense, durable castings with a hard, smooth surface—an excellent finish that takes a high polish. No individual inspection is required.

Let Phoenix estimate on some of your parts.

PHOENIX DIE CASTING CO.

Established 1907 **BUFFALO, N. Y.**

Kent-Owens

SPECIAL MACHINERY

Solicit Your Inquiries

Whether your requirements call for an appliance weighing a few ounces or an intricate machine, weighing 100 tons, we are equipped to serve you. No order is used as a "fill in" to a specialized product. Each one receives the attention necessary for accuracy, permanency, low cost and to make deliveries as promised. Your inquiries, drawings or blueprints covering any proposition you may have will be gladly received and will be given our immediate attention and quotation supplied promptly.

The Kent-Owens Machine Company
Toledo, Ohio

STERLING DIE CASTINGS

Accurate Dimensions and Good Finish

Quotations Promptly Given from Samples or Blueprints. Low Die Charges.

STERLING DIE CASTING CO., INC.,
743-39th Street **Brooklyn, N. Y.**

DIE CASTINGS

Aluminum, Tin, Zinc and Lead

Republic Die Casting Company, Inc.
128E Mott Street **NEW YORK CITY**

DOEHLER DIE-CASTINGS

SOME FACTORS IN VALUE

ALLOYS—A mistake is frequently made in specifying a die-casting without regard to the alloy to be used.

All die-castings are not alike, as neither all sand-castings are alike, nor all forgings are alike. A sand-casting made from brass bears no relation to one made from iron or monel metal. Similarly, a die-casting made from aluminum has properties entirely different from a die-casting made from tin or lead alloys.

The alloys used in die-casting practice can be classified in four groups:

Tin Base Alloys — *Zinc Base Alloys*
Lead Base Alloys — *Aluminum Base Alloys*

The principal compositions used by the Doehler Die-Casting Co. are described in our new booklet, which might properly bear the title *"What Every Die-Casting User Should Know."*

It is a book you should have. Your copy is ready. Use the coupon attached.

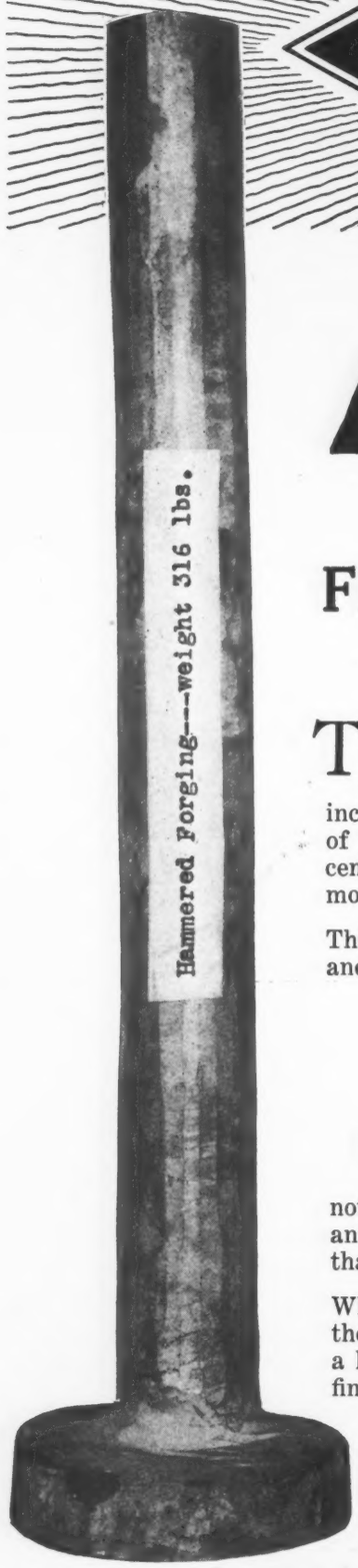
DOEHLER DIE-CASTING CO.

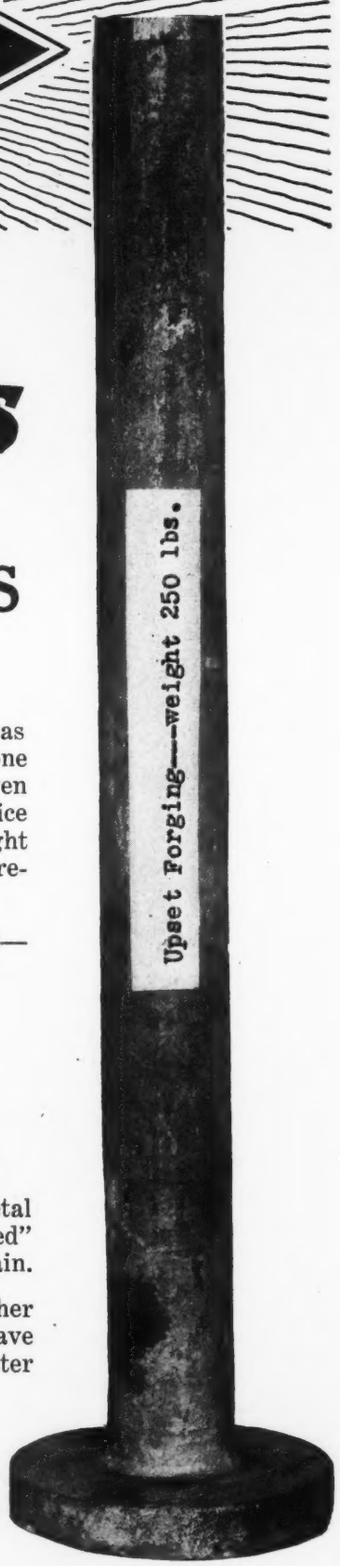
BROOKLYN, N.Y. — TOLEDO, OHIO.
POTTSTOWN, PA. — BATAVIA, N.Y.

DOEHLER DIE-CASTING CO., COURT & 9TH STS., B'KLYN, N.Y.
I attach my business card and will be pleased to have you send me your new booklet
DOEHLER DIE-CASTINGS ©

AM FORGE

Upset Forgings





FLANGED SHAFTS

For Instance—

THE large shaft illustrated at the right was upset from 4¼" open hearth rounds in one heat and three operations on one of our seven inch forging machines. Customer saved the price of 66 pounds of open hearth steel, twenty-eight cents in freight, plus the machining time, in removing 66 pounds of excess material.

This is by no means our largest flanged shaft—and our sizes range down to "pocket editions."

Many Sizes in Stock
and dies on hand for making many others

Upset Forged Gear Blanks

not only effect a corresponding saving in metal and machining, but the metal is so "gathered" that all gear-teeth are cut against a radial grain.

Whatever your forgings, let us determine whether they can be *upset forged.* If they can, you'll save a lot of money and give your customers a better finished product.

Send Blue Prints
for Estimates

AMERICAN FORGE COMPANY
2625 South Hoyne Avenue, Chicago, Ill.

STANDARD PUNCH and DIE SETS

Yours on Demand

Diagonal and Rear Pins

These ruggedly constructed sets have resisted press-room abuse under all operating conditions.

Send your problems to our TOOL SERVICE and MANUFACTURING departments.

DIAMANT TOOL & MFG. CO., Inc.
95 Runyon Street NEWARK, N. J.

Here's a Proposition—

Send blueprints and let us estimate on your gear blanks, spindles, weldless rings, etc. Our prices will surprise you just as they surprise every one who expects costs as high as Dyson Forgings are excellent.

The quality of Dyson Forgings is as established as the sun. The Dyson way of heat-treating improves the physical properties of ordinary annealed steel from 50 to 75%.

Anything from a 3" nut to a 5 ton shaft, forged well and delivered promptly.

JOSEPH DYSON & SONS
CLEVELAND OHIO, U. S. A.

Wood and Metal Patterns Gray Iron Castings Machine Work

SWEET & DOYLE FOUNDRY & MACHINE CO.
Troy (Green Island), N. Y.

Use Hollow Bored Forgings?

Let us quote on your requirements. We can probably save money for you on high-grade parts of this character. Send blueprints or sketch.

AMERICAN HOLLOW BORING CO., Erie, Pa.

Flat Die Forgings to Any Blue Print or Any Grade of Steel

THE MACHINERY FORGING COMPANY
5450 Hamilton Ave. CLEVELAND, OHIO

DIE COSTS REDUCED

KELLER AUTOMATIC MACHINES
CUT ANY SIZE DIES
KELLER MECHANICAL ENGINEERING CORP.
74 WASHINGTON ST. BROOKLYN, N.Y.

The Reo Motor Car Company, Lansing, Michigan, uses HOYT *Babbitt and Solder*

HOYT BABBITT

Where It's Different

AS far as outward appearance is concerned, there may be no difference between HOYT Babbitt and that of some unknown manufacturer. But when subjected to the acid test of active service, the inherent high quality of the HOYT product quickly differentiates it. The use of HOYT Babbitt for anti-friction service is your best protection against the too-frequent necessity of rebabbitting — against costly interruption of production.

Protect your investment by demanding only HOYT Babbitt

GENUINE "A"
Wherever a Genuine Babbitt is Desirable

EAGLE "A"
At a price lower than you will expect.

If your jobber can't supply you, we'll tell you who will—write us.

HOYT METAL COMPANY
ST. LOUIS-CHICAGO-DETROIT-NEW YORK
ALSO MANUFACTURERS OF
SOLDER-SHEET LEAD
BEARINGS *AND*
DIE CASTINGS

Let's Analyze this Ramsey Chain

Let's Get a Little Technical

1st—You, as an Engineer, will admit that a Silent Chain in passing around a Sprocket, in reality, is passing over the flat sides of a pitch polygon having as many faces as there are teeth in the Sprocket.

2nd—That when the flat sides of the polygon are in line with the pull of the chain, the Sprocket has a certain pitch radius.

3rd—That when the points of the polygon come over, this pitch radius is increased.

4th—That this variation in pitch radius sets up in the chain a series of Lineal Pulsations, which have destructive effects upon the chain parts.

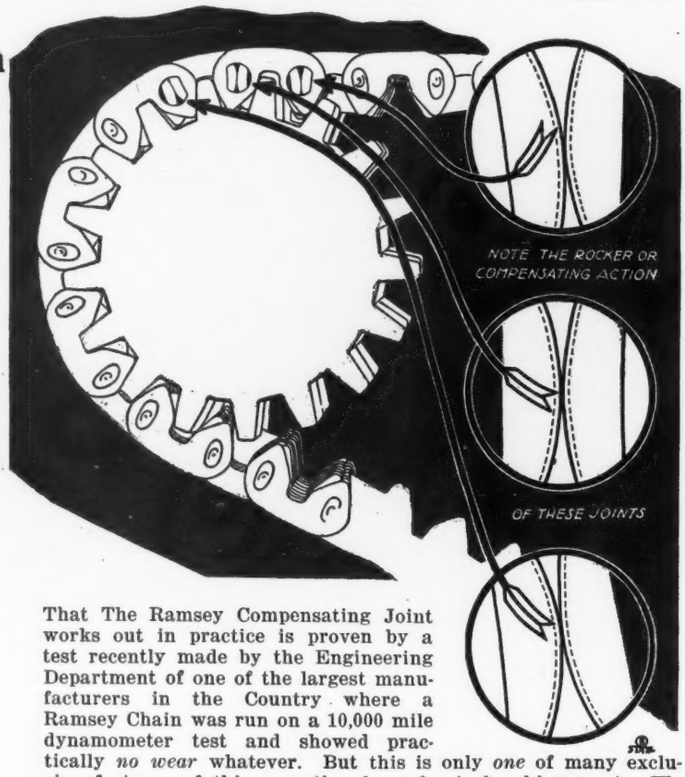
5th—That in order to withstand these repeated shocks, previous practice has necessitated the use of comparatively soft links.

6th—That the Ramsey Compensating Joint corrects this variation in the pitch radius within the joint itself.

7th—That not being subjected to Lineal Pulsations, the Ramsey links are made much harder, which results in greatly improved, wear-resisting qualities.

Ramsey Chain Co., Inc.

1039 Broadway, Albany, N. Y.
41 E. 42nd St., New York City
855 Leader-News Bldg., Cleveland



That The Ramsey Compensating Joint works out in practice is proven by a test recently made by the Engineering Department of one of the largest manufacturers in the Country where a Ramsey Chain was run on a 10,000 mile dynamometer test and showed practically *no wear* whatever. But this is only *one* of many exclusive features of this sensational mechanical achievement. *We will gladly send any prospective user of Silent Chain a sample for test.*

NOTE: The Roller Bearings wear uniformly (shown by dotted lines) thus retaining true rolling action throughout the entire life of the chain.

Dependable!

—Manufacturers who want absolute dependability, Specify

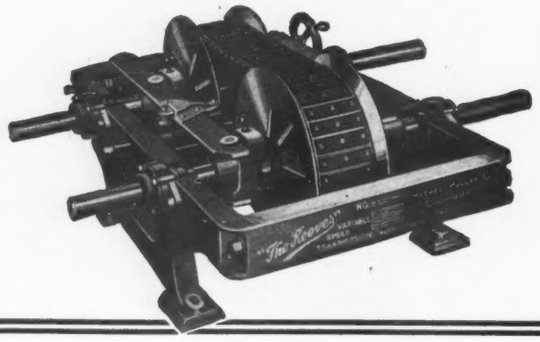
"The Reeves" VARIABLE SPEED TRANSMISSION

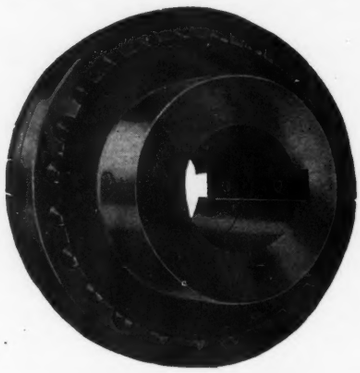
Present day production methods demand absolute dependability in variable speed control. Machines must be equipped for a wide range of speed variation. And they must never vary when they are set to run at any definite speed.

That's why progressive manufacturers specify "The Reeves" Variable Speed Transmission to control the machines and conveyors in their plants. They know that its unfailing accuracy and absolute dependability saves money and improves production.

"The Reeves" Transmission will drive any machine at any desired speed, and will hold that speed, steadily and evenly, until you change it. Easy to install. Simple to operate. Pays for itself in a short time. Lasts for years. Investigate "The Reeves" Transmission and what it will do in your plant.

REEVES PULLEY CO. 1230 Seventh St. Columbus, Ind.





Francke flexible couplings save needless installing and operating-trouble costs. They are flexible in every direction. All metal and durable. And in addition cushion load shocks, vibrations, etc.

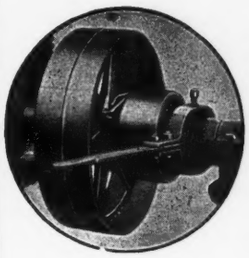
There are five different Francke types to meet all usual and special operating conditions—sizes from ¼ H.P. to 8,700 H.P. Depending upon operating conditions some should be lubricated, but in most cases a Francke needs no attention after it is installed—and it lasts for years.

All sizes—Catalog on request.

FRANCKE FLEXIBLE COUPLINGS
"They make good machines last longer"

SMITH & SERRELL
Coupling Specialists Since 1912
62 Washington St., Newark, N. J.

No Burned Out Bearings!
No Scored Shaftings!

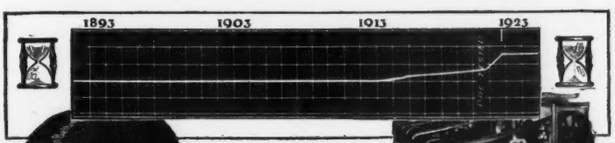


The higher the speed, the tighter the grip of Mule Pull Clutches. They lock immediately when engaged; plenty of space between plates eliminates any tendency to drag when disengaged. The ring oiling system floods the bearing at every revolution.

Here is a direct machine drive that reduces costs and increases operating efficiency.

Expanding ring and disk types, let us tell you about them.

Brown Engineering Co.
133 N. THIRD ST., READING, PA.



Leather Belts that are 25% *better* than the best belts of 10 to 20 years ago

CHICAGO Belting pre-tested leather belts are approximately that much better than the best leather belts of 10 to 20 years ago. The leather is better tanned for belting purposes—the belts are better made—the surface has a 25% better grip on the pulley, and the belts are pre-tested. For machine tool drives pre-tested leather belts increase machine output and outlast other belts—according to the records of hundreds of machine shops who now use these belts. The test rating of each belt we deliver is guaranteed and we stand back of every belt we deliver for the entire life of the belt.

The "pre-tested" method is described in a new booklet just off the press. If you are a reader of Machinery, write for a free copy.

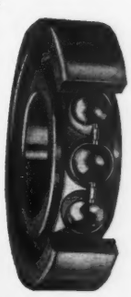
Chicago Belting Company
Manufacturers of Leather Belting
127 NORTH GREEN STREET
CHICAGO, U.S.A.
NEW YORK, PITTSBURG, CLEVELAND, ROCKFORD, MILWAUKEE
NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, PORTLAND, ORE., SEATTLE, WASH.

Do You Get All the Power You Pay For?

Power lost in bearing friction is gone beyond all recovery. You pay for it but you cannot use it.

Gurney Ball Bearings limit the frictional loss to the absolute minimum.

Machinery equipped with Gurney bearings deliver 100% of the power which it is possible to obtain.

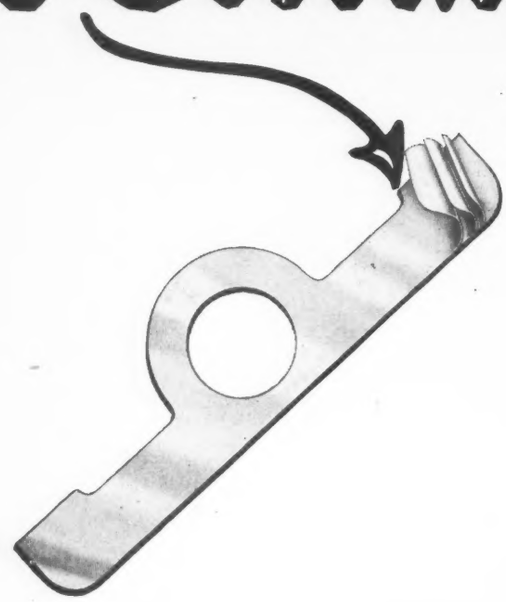


Gurney Maximum Service—Maximum Capacity Ball Bearings solve bearing problems

18245

GURNEY
BALL BEARINGS
Marlin-Rockwell Corp., Jamestown, N. Y.

PEEL SHIMS



When making split bearing adjustments, use LAMINATED Shims. All you have to do is peel off the layers with a pocketknife.

LAMINUM is composed of layers of very thin shim brass, .003 inch thick joined by a metallic binder into one solid piece. Obtainable in sheets, or strips of any desired size up to 6″ wide by 36″ long, easily cut to fit bearing dimensions.

Or, we will make shims in accordance with your own specifications. Wherever there is a split bearing—use LAMINUM.

Write for free sample and complete information

LAMINATED SHIM CO., Inc.

221 14th St. Long Island City, N. Y.

LAMINUM

Simplicity is the Keynote of Efficiency

The Conway Clutch is made of five, simple, interchangeable parts.

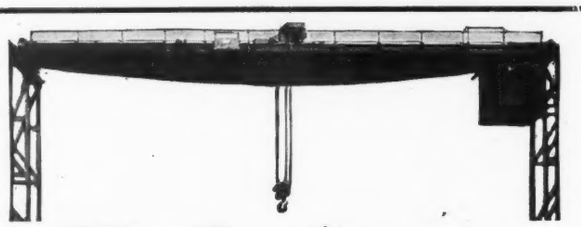
1. Carrier
2. Cone
3. Friction Band
4. Lever
5. Latch

It embodies every efficient clutch principle and employs but five parts to do it. A trial order will convince you.

Write for the Catalog

The Conway Clutch Co.

1962 West Sixth Street, Cincinnati, Ohio



P&H Traveling Cranes and Hoists

PAWLING & HARNISCHFEGER CO.

3826 National Avenue Milwaukee, Wis.

Offices and Agents in Principal Cities

Hjorth Perfection Spring Winder

No factory complete without one. Makes every kind of springs. Right or left-hand.

Capacity to 3/32 wire	$1.25
Capacity to 3/16 wire	2.50
Capacity to 5/16 wire	5.00

If interested, send for circular

(Patented)

Hjorth Lathe & Tool Company

10 Tremont St., Boston, Mass.
Works: Woburn, Mass.

How Not to Make Workmen Idle While Keyseating a Shaft: Easy! Do it during lunch hour, when men are idle anyway, with the Burr Portable Keyseater. Mills a keyway up to 12″ long in shafts 5″ in diameter in one setting without dismantling shaft. *All during the noon hour!* Send for details.

JOHN T. BURR & SON, 432 KENT AVENUE BROOKLYN, N. Y.

"When you buy the Burr you buy the best"

MORSE SILENT CHAIN DRIVES

Morse Silent Chains driving from motors to lineshaft in machine shop: Willys-Morrow Co., Elmira, N. Y

These makers of transmissions know Morse Chain reliability

The ability of Morse Silent Chain to transmit power with 98.6% efficiency over short centers, their smoothness and flexibility in running, their freedom from slippage and frequent repairs—induced their installation in this modern machine shop.

As makers of positive power transmission units for automobiles, the Willys-Morrow Co., of Elmira, N. Y., naturally turned to Morse Chains as the logical drive for transmitting power to help turn out a quality product.

A large number of Morse Silent Chains, ranging in size from 15 to 40 horsepower, drive the line shafts from motors. In some cases motors are connected by Morse Chains directly to the countershafts of individual machines.

All motors, 20 horsepower and less, are installed 30 inches from center of motor shaft to center of lineshaft. Larger than 20 horsepower, 36 inch centers. Approximately ninety percent of line shafts are operated at 300 R.P.M., the remainder at 200 R.P.M.

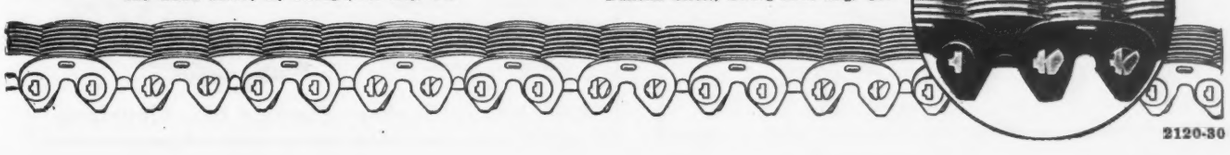
From the lineshaft the group method is employed to drive the following types of machines: Fellows Gear Shaper; Automatic and Hand Screw Machines; Nut Tappers; Drill Presses; Potter & Johnston Automatics; Jones & Lamson Lathes; Norton and Heald Grinders; and various other machine tools.

Every machine shop, large or small, can have as reliable power transmission as the Willys-Morrow Co., and may be assured of 98.6% of the developed horsepower of the driving unit, by installing Morse Silent Chain Drives. Any Morse Engineer will gladly assist in planning a suitable layout.

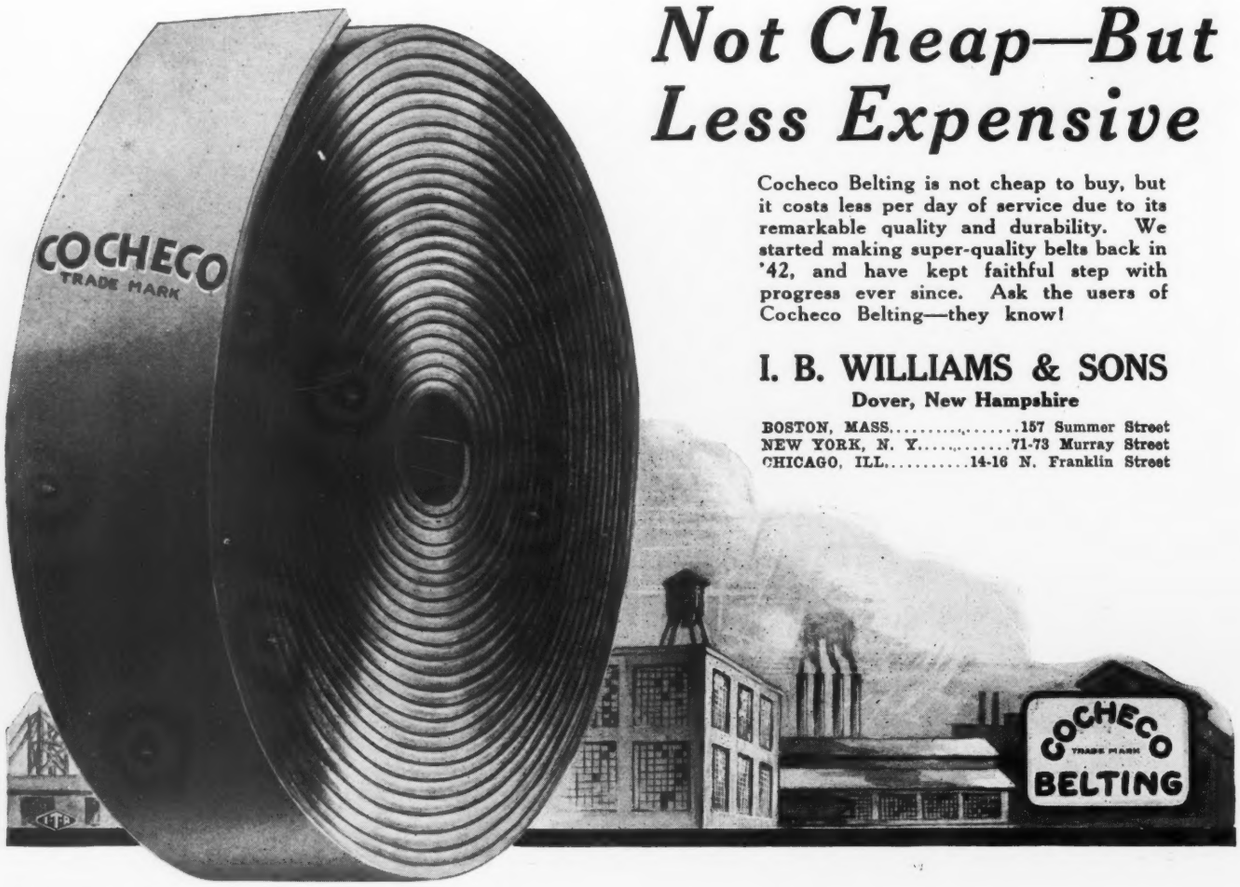
MORSE CHAIN CO., ITHACA, N. Y.

There is a Morse Engineer near you

ATLANTA, GA...702 Candler Bldg., Earl F. Scott & Co.
BALTIMORE, MD. .....1402 Lexington Bldg.
BOSTON, MASS. .....141 Milk Street
CHARLOTTE, N. C.....404 Commercial Bank Bldg.
CHICAGO, ILL.....Room 803, 112 W. Adams Street
CLEVELAND, OHIO.....421 Engineers Bldg.
DENVER, COLO....1761 Wazee Street, R. M. Parsons
DETROIT, MICH.....7601 Central Avenue
NEW YORK CITY.....Room 1871, 50 Church Street
MINNEAPOLIS, MINN.,
413 Third Street, S., Strong-Scott Mfg. Co.
MONTREAL, QUE., CAN.,
St. Nicholas Bldg., Jones & Glassco, Reg'd
PHILADELPHIA, PA.....612 Franklin Trust Bldg.
PITTSBURGH, PA.....Westinghouse Bldg.
SAN FRANCISCO, CAL. .....Monadnock Bldg.
ST. LOUIS, MO.,
Railway Exchange Bldg., Morse Chain Co.
TORONTO, ONT., CAN.,
Bank of Hamilton Bldg., Jones & Glassco, Reg'd
WINNIPEG, MAN., CAN.,
Dufferin Street, Strong-Scott Mfg. Co.



2120-30



Not Cheap—But Less Expensive

Cocheco Belting is not cheap to buy, but it costs less per day of service due to its remarkable quality and durability. We started making super-quality belts back in '42, and have kept faithful step with progress ever since. Ask the users of Cocheco Belting—they know!

I. B. WILLIAMS & SONS

Dover, New Hampshire

BOSTON, MASS.....157 Summer Street
NEW YORK, N. Y.....71-73 Murray Street
CHICAGO, ILL.....14-16 N. Franklin Street

DUCKWORTH

Chains and Sprockets

DUCKWORTH Chains and Sprockets meet the most exacting requirements of durability and accuracy. Their reasonable prices allow a considerable money saving.

Our engineering department will be glad to give individual attention to your requirements.

Established 1871

Duckworth Chain & Mfg. Co.

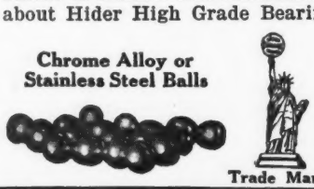
Mill and Locust Sts. Springfield, Mass., U.S.A.

HIDER STEEL BALLS

are Accurate to 0.0001"

Hider Steel Balls are hardened all the way through, evenly and uniformly, from circumference to center. Each ball is individually inspected and guaranteed accurate to a tenth of a thousandth. Let us tell you more about Hider High Grade Bearing Balls.

Chrome Alloy or Stainless Steel Balls



Trade Mark

Small sizes only, 1/32 inch to 5/16 inch

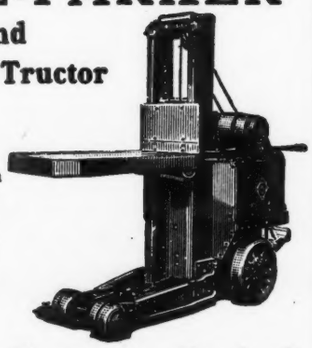
HIDER STEEL BALL WORKS

1234 Industrial Avenue BINGHAMTON, N.Y., U.S.A.

ELWELL-PARKER

6000 Pound

Elevator Hi/Lo Tructor



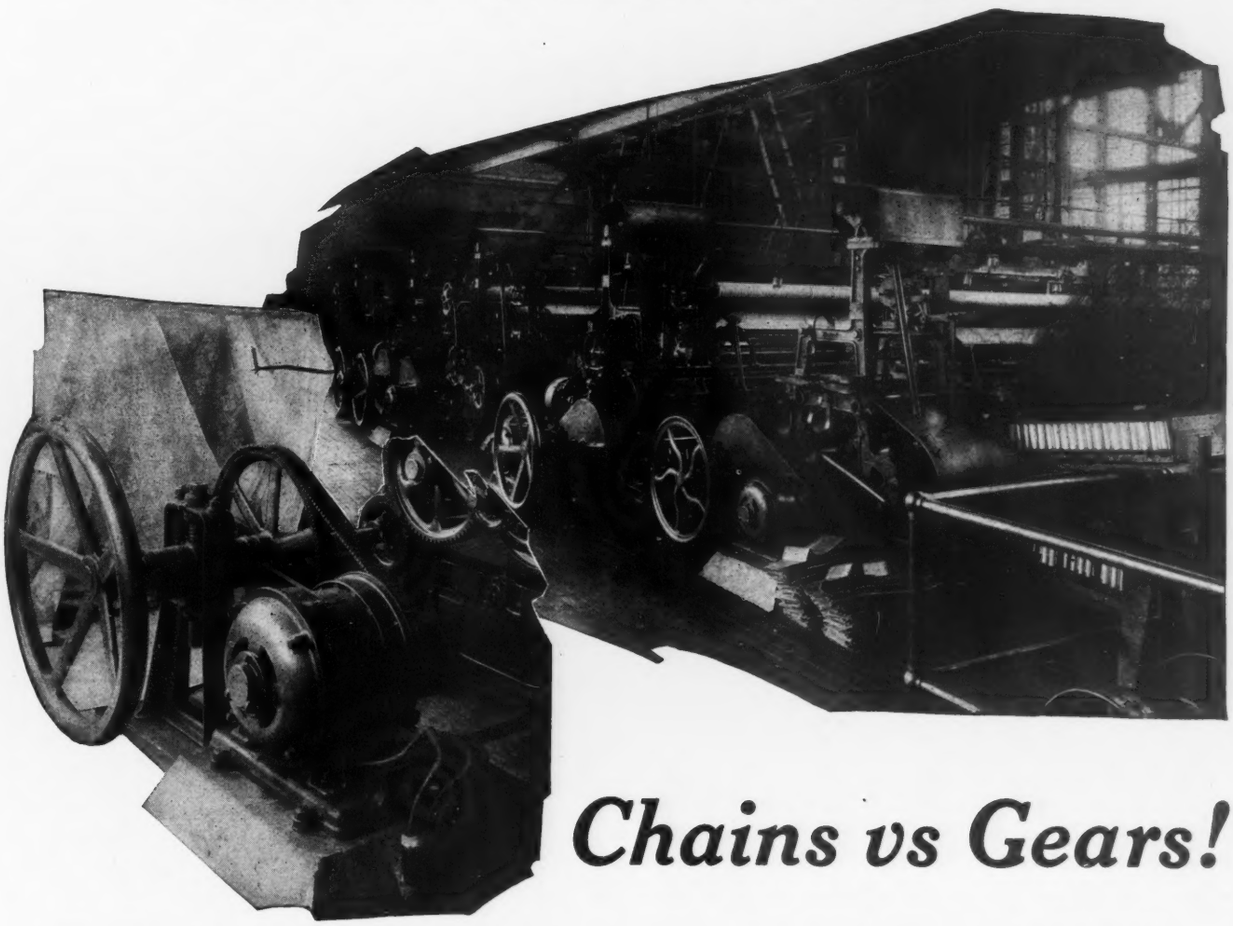
Greatest capacity
Largest drive wheels
Dual tires under platform
New patented lift system
Fewest number of parts
New safety controls
Husky and dependable

Request catalog 430

The Elwell-Parker Electric Co., Cleveland

"WHITNEY"

Silent Chain Drives



Chains vs Gears!

The illustration above shows only a few of a very large installation of "WHITNEY" Silent Chain Drives on looms in a large lace plant.

These looms were formerly driven by belts and gears, but vibration and slippage impaired production with losses in power.

To ensure a product of more uniform quality, "WHITNEY" Silent Chains were installed. Delivering practically every ounce of power from the motor to the loom these silent, smoothly running "WHITNEY" drives eliminated vibration and slippage.

They have been operating for a number of years to the complete satisfaction of the owners.

Let our Engineers fit the drive to the job

THE WHITNEY MFG. CO.

HARTFORD, CONN.

SALES AND ENGINEERING OFFICES.

NEW YORK
L. C. Biglow & Co., Inc.
243 W. 55th St.

PITTSBURGH
Pittsburgh Gear & Mch. Co.
27th and Smallman Sts.

BOSTON
George C. Steil
740 Commonwealth Ave.

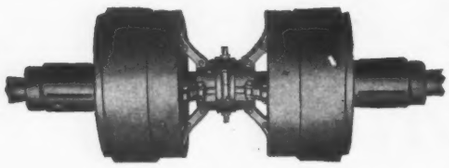
SAN FRANCISCO
A. H. Coates Co.
615 Howard St.

PHILADELPHIA
R. J. Howison
624 Race St.

SEATTLE
A. H. Coates Co.
1115 East Union St.

CHAINS AND SPROCKETS FOR POWER TRANSMISSION

M & W—The Clutch That Holds—



—the clutch that cannot become accidentally engaged and can be stopped *instantly;*
—that has no projecting parts;
—that is self-contained, dustproof and economical to maintain;
—that is in use in upward of 300,000 shops, in all parts of the world—often transmitting 500 H.P. speeds up to 2500 R.P.M.

More details on request.

THE MOORE & WHITE CO.
Established 1886
2707-2737 North 15th St., Philadelphia, Pa.

Sold by leading dealers in Mine, Mill and Factory Supplies

Booklets every manufacturer needs—write for yours TODAY!

BEARINGS

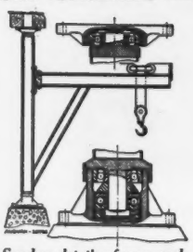
BALL BEARINGS
SINGLE AND DOUBLE ROW
ROLLER BEARINGS

LARGE STOCKS ON HAND
ALL MAKES :: MOST SIZES

UNUSUALLY ATTRACTIVE PRICES
LET US KNOW YOUR REQUIREMENTS
WE PURCHASE SURPLUS BEARINGS

S. BREAKSTONE
63 EAST HARRISON ST. CHICAGO, ILL.

JIB CRANES OPERATE RAPIDLY ON AUBURN THRUSTS



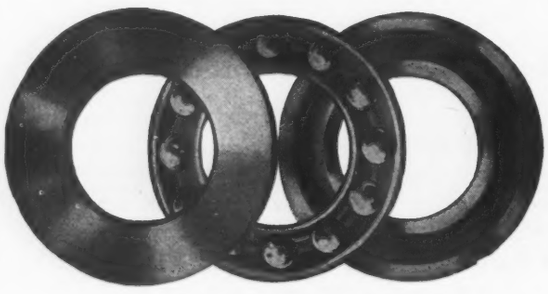
Send us details of your problems and let us assist you.

Shop Jib Cranes and other slow moving machine parts are turned easily under the heaviest loads when Auburn Ball Bearings are installed to reduce the starting friction.

STEEL, BRASS AND BRONZE BALLS

AUBURN BALL BEARING CO.
33 Elizabeth St. Rochester, N. Y.

THE BEARINGS COMPANY OF AMERICA



manufacturers of STAR Ball Retainers for Thrust, Magneto and Cup and Cone types of Bearings. Complete Thrust Ball Bearings, Angular Contact Thrust Bearings and Angular Contact Radial Bearings (made to your B/P's and requirements).

THE BEARINGS COMPANY OF AMERICA

Western Sales Office,
1012 Ford Bldg., Detroit, Mich.

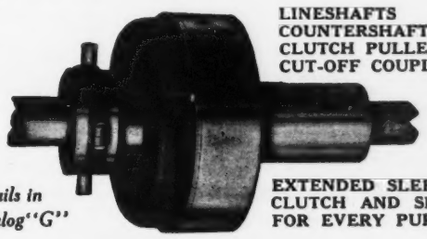
LANCASTER, PA.

Go through the modern shop

Go through the modern shop—efficiency and economy are the requirements of every article of equipment. Notice the many instances where transmission of power is controlled by **Edgemont Friction Clutches.** These devices give high efficiency, economy and safety in power control equipment.

EDGEMONT CLUTCHES

have burn-proof brake linings—readily renewable; are dustproof; pick up load gradually or at once; stop instantly; localize power consumption in productive units and relieve motive machinery of all torque except its own.



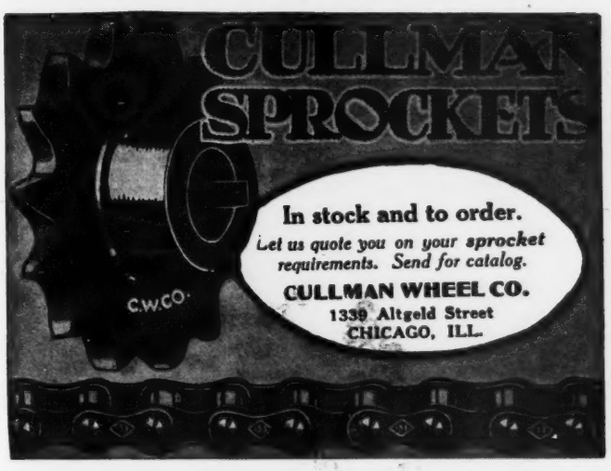
LINESHAFTS
COUNTERSHAFTS
CLUTCH PULLEYS
CUT-OFF COUPLINGS

Details in Catalog "G"

EXTENDED SLEEVE CLUTCH AND SPECIALS FOR EVERY PURPOSE

Extended Sleeve Clutch Expanding "Type B" for driving wood, steel, or cast-iron pulleys, gears, drums, rope sheaves, sprocket wheels, etc., on the sleeve.

The Edgemont Machine Company
2700 National Avenue, DAYTON, OHIO



MECHANICAL BELT SHIFTERS FOR CONE PULLEYS

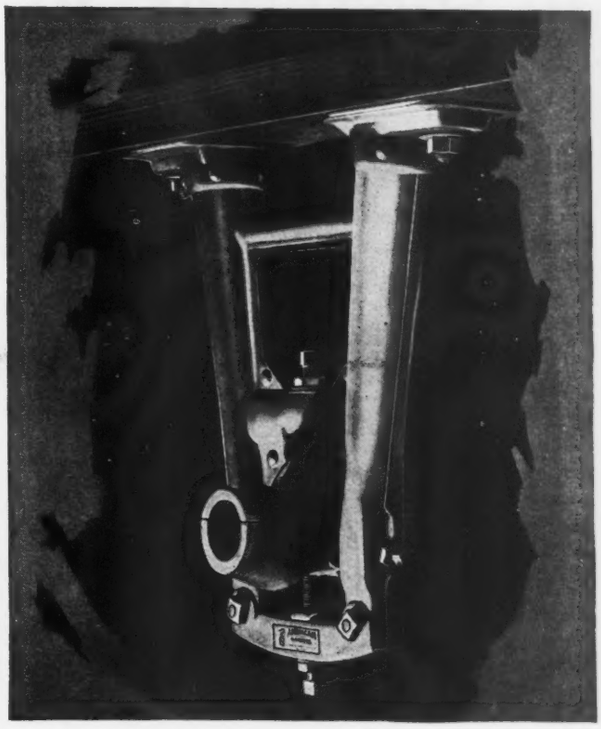
Afford absolute protection against all belt accidents.

KREMER-CUMMINS MACHINE COMPANY
6011 LEXINGTON AVE., CLEVELAND, OHIO

CRANES All Types

WHITING CORPORATION
HARVEY-ILL. U.S.A.
(CHICAGO SUBURB)

Foundry Equipment



PATENTS PENDING

DESIGNED, as they are, to fulfill the most exacting demands of modern power transmission engineers, American Pressed Steel Hangers are the present ultimate of shaft hanger construction.

The American Hanger design is the outgrowth of a quarter century of practical research in the problems of power transmission.

It is for this reason that you can buy American Pressed Steel Hangers protected by so broad a guarantee.

You will be interested in the details. They are worth examining. Write to

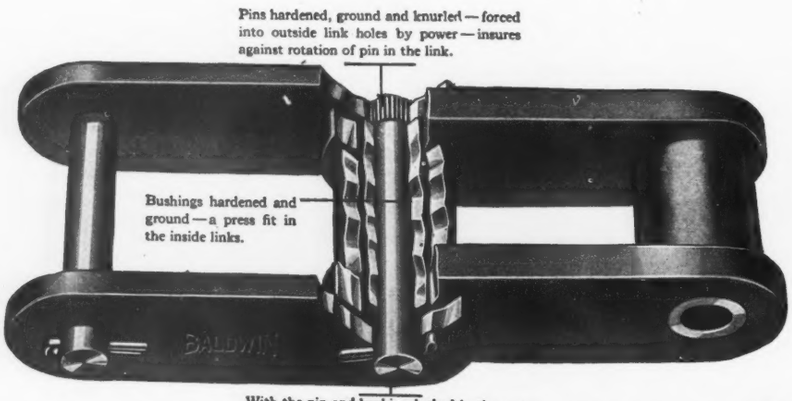
The American Pulley Company
Manufacturers of Steel Split Transmission Pulleys, Pressed Steel Shaft Hangers and Pressed Steel Shapes
4200 Wissahickon Ave. Philadelphia
See MacRae's Blue Book for nearest distributor.

PATENTED

The six million American Pulleys in use in this and other countries attest the kind of service that may be expected of them.

AMERICAN
PRESSED STEEL HANGERS | STEEL SPLIT PULLEYS
PATENTS PENDING. PATENTED

In Operation—In Final Cost


Pins hardened, ground and knurled—forced into outside link holes by power—insures against rotation of pin in the link.
Bushings hardened and ground—a press fit in the inside links.
With the pin and bushing locked in the outer and inner links respectively, wear is evenly distributed over the entire length of pin and bushing.

BALDWIN CHAINS

are Economy Plus, they mean Continuous Production

Our New Catalog G

gives complete information, with many interesting illustrations and much valuable Engineering Data.

This Superior Design, these High Grade Steels, this Excellence of Workmanship, entering into the construction of **all Baldwin Chains**—why should you know about this subject?

To the user, it means positive assurance that, for **(1) Accuracy, (2) Resistance to Wear, (3) Minimum Stretching (Long life), (4) Nearly Dust-tight Construction, Baldwin Chains** are unsurpassed.

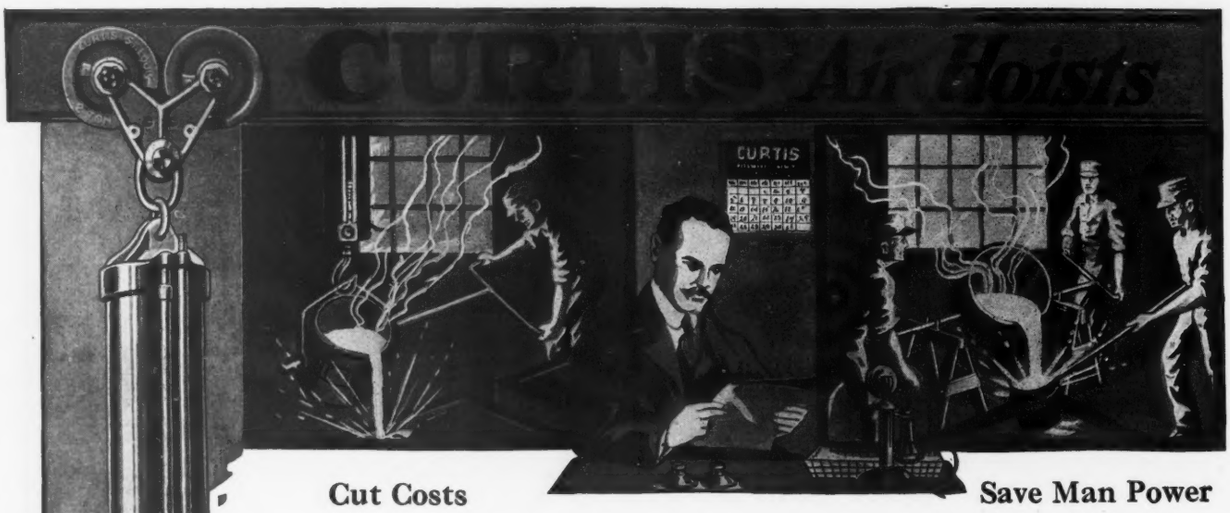
And don't overlook our facilities for the manufacture of **Accurate Sprockets.**

BALDWIN CHAIN & MFG. CO., Worcester, Mass.

H. V. GREENWOOD,
General Western Sales Representative, Peoples Gas Bldg., Chicago, Ill.

LYMAN TUBE & SUPPLY CO., LTD.,
Canadian Representatives, Montreal, Toronto.

CURTIS Air Hoists



Cut Costs **Save Man Power**

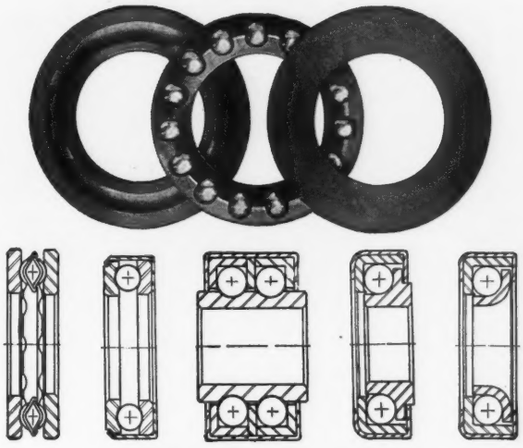
CURTIS AIR HOISTS are increasing production, cutting down man power, lessening accidents and reducing manufacturing costs in hundreds of America's leading industrial plants. One man with a Curtis Hoist, operated in connection with an overhead Curtis I-Beam Trolley, can move tremendous loads with ease and can practically do the work of three men.

Write us regarding your needs. Our Engineering Department is at your service. Illustrated descriptive literature and complete information on request.

CURTIS PNEUMATIC MACHINERY COMPANY
1568 Kienlen Avenue St. Louis, Mo.
Branch Office: 530-G Hudson Terminal. New York City

NICE
TRADE MARK
REG. U.S. PAT. OFF.

BALL BEARINGS



ECONOMICAL—EFFICIENT

In stock for immediate delivery at twenty distributing points in the United States.

SEND FOR CATALOG.

BOSTON GEAR WORKS

NORFOLK DOWNS, QUINCY, MASS.

BOSTON NEW YORK CLEVELAND CHICAGO

The BANTAM BALL BEARING Co.

BANTAM, CONN., U.S.A.

Thrust Bearing Specialists

Bearings Made To Your Requirements

For all Types of Machinery

ROEPER

ELECTRIC AND HAND POWER

TRAVELING CRANES

MONO-RAIL HOISTS

TROLLEYS

ROEPER CRANE & HOIST WORKS

READING, PA.

22 Years of Service *Without Oil*

This Arguto Bearing was in constant use on the countershaft of an 18-Inch Lodge & Davis engine lathe for twenty-two years—and when taken down showed only .0124″ wear (inside diameter), not a cut or scratch and an inner surface that was polished like a mirror.

The shaft diameter was 1-7/16″; R.P.M. 230; wear on shaft .003″ to .004″. The bushing was 5⅝″ long; 2¼″ outside diameter; 1-7/16″ inside diameter.

Wouldn't such service be of value to you?

ARGUTO OILLESS BEARING CO.

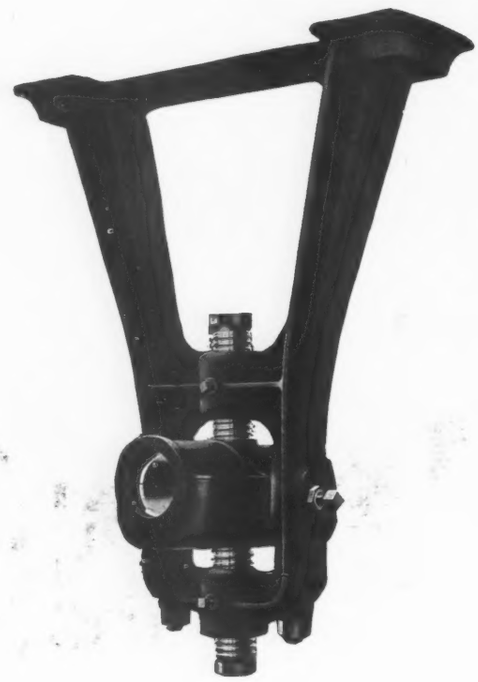
145 W. Berkley St. Wayne Junction, Philadelphia

Arguto ©A.O.B.Co.,1924

OILLESS BEARINGS

POWER TRANSMITTING MACHINERY

Buy— then forget it



No material withstands so effectively the thrusts and pull of hanger service as *Cast Iron.* That has been proven to our complete satisfaction, and the unquestioned benefit of thousands of users.

The "Universal Giant" Ring Oiling, Ball and Socket, Cast-iron Hanger is permanent equipment—practically indestructible. *Buy—and then forget it.* It holds shafting in a fixed position without spring, bend or play.

Buy for generations of service not a year. Cast-iron Hangers which we built and put in service 50 years ago are as good as ever. What better proof than that?

Let us send you all the facts.

T. B. WOOD'S SONS COMPANY
CHAMBERSBURG, PA.

BY INVITATION MEMBER OF
THE FRANKLIN INSTITUTE
NEW YORK, U.S.A.

FORD
Tribloc Chain Hoists

These hoists have 80% efficiency. For example, an eighty-two pound pull on the chain of a 1-ton Tribloc will lift a ton. Made in capacities from ¼ to 20 tons.

Write for Catalog 6-B

FORD CHAIN BLOCK CO., 2nd and Diamond Sts., PHILADELPHIA, PA.

Overseas Representative: Allied Machinery Co. of America, 90 Wall St., New York, N. Y.

2236-D

STEEL BEARING BALLS

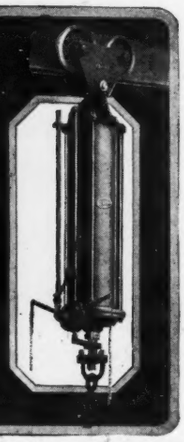
BRASS AND BRONZE BALLS

STEEL BURNISHING BALLS

ASK FOR PRICE LIST 104

THE ABBOTT BALL CO.
ELMWOOD HARTFORD, CONN.

HANNA
AIR HOISTS and TROLLEYS
for SPEED ACCURACY ECONOMY



HANNA ENGINEERING WORKS
1763 ELSTON AVE. CHICAGO, ILL.
Birmingham, Ala. Detroit Los Angeles New York Portland, Ore. Richmond, Va. San Francisco St. Louis

Three Area Contact

This is an exclusive feature of Schatz "Universal" Annular Ball Bearings. It is the principle upon which all Federal Bearings operate, and is directly responsible for the great thrust and radial load capacity, the long life, and high efficiency of the

Schatz "UNIVERSAL" Registered U.S.Pat.Off. Annular BALL BEARING

The resulting adaptability has earned for "Universal" Bearings the high regard of foremost engineers everywhere.

THE FEDERAL BEARINGS CO., Inc.
POUGHKEEPSIE
N. Y.

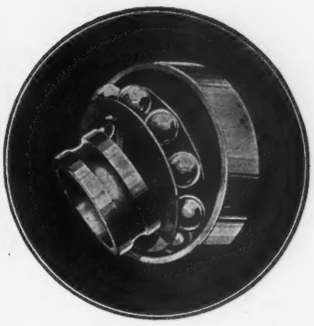
The Canton Portable Floor Crane

Any Place in the Shop

"The Handiest Tool in the Shop"

Setting up a new machine, shifting an old one, carrying heavy parts—one man can do it with this efficient aid. Capacity to 6000 pounds.

CANTON FOUNDRY & MACHINE COMPANY
CANTON, OHIO
New York, 203 East 15th Street



"NORMA" BALL BEARINGS
For High Speed High Duty Service
—
Open and Closed Types

PRECISION BEARINGS

Make Good Machines Better

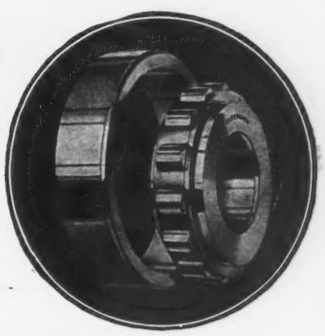
The worth-while reputations in the machinery world are enjoyed by those manufacturers who—in their designing and building and buying—consider not only their own production costs but also the operating and upkeep costs which their customers must pay.

Service records prove that machines equipped with "NORMA" and "HOFFMANN" Precision Bearings cost less to operate, last longer, do more work, cost less to maintain. Our engineers are ready to meet yours, with convincing facts of actual performance.

THE NORMA COMPANY OF AMERICA
Anable Avenue
Long Island City New York
BALL, ROLLER AND THRUST BEARINGS

HOFFMANN

ROLLER BEARINGS
For Heavy Loads and Hard Service
—
Standard and Self-aligning Types



EXCELLENCE Without Extravagance

Schatz "Commercial" Annular Ball Bearings are intended for locations where a true anti-friction bearing is required, but where the duty is not severe and where economy is essential.

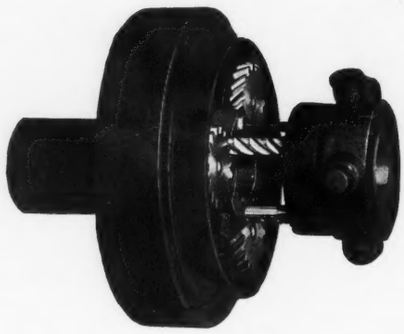
However, they should not be confused with various crudely made bearings. The exclusive three-contact design gives to "Commercial" bearings high efficiency and long life, and enables them to sustain thrust loads in *either* direction up to 50% of their radial load capacity.

Commercial
ANNULAR BALL BEARINGS

A new catalog gives the only published data as to load capacities and the uses of the less expensive grades of annular ball bearings. Send for it, and also discount sheets and samples.

THE SCHATZ MANUFACTURING CO.
Poughkeepsie, N. Y.

Hilliard Friction Clutches



Modern Factory Equipment

Direct, instantaneous and positive control insures maximum operating efficiency for each machine. It reduces the belting and countershafting required to drive the machines, lowers equipment and upkeep costs, reduces power waste.

The clear overhead achieved by the use of Hilliard Friction Clutches on each machine makes this method of individual control particularly popular in modern daylight plants. Hilliard Friction Clutches work well, wear well, increase production capacity, cut costs. Let us tell you about them.

The Hilliard Clutch & Machinery Co.
ELMIRA, N. Y.

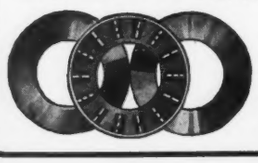
CRESSON-MORRIS CO.

Power Transmitting Machinery

We make a specialty of equipping plants completely with power transmission machinery; including shafting, rope-transmission, machine cut and molded iron and steel gears for heavy service.
Over sixty years' experience and competent engineering advice are at your disposal.

CRESSON-MORRIS COMPANY
Engineers—Founders—Machinists
PHILADELPHIA PENNA., U. S. A.

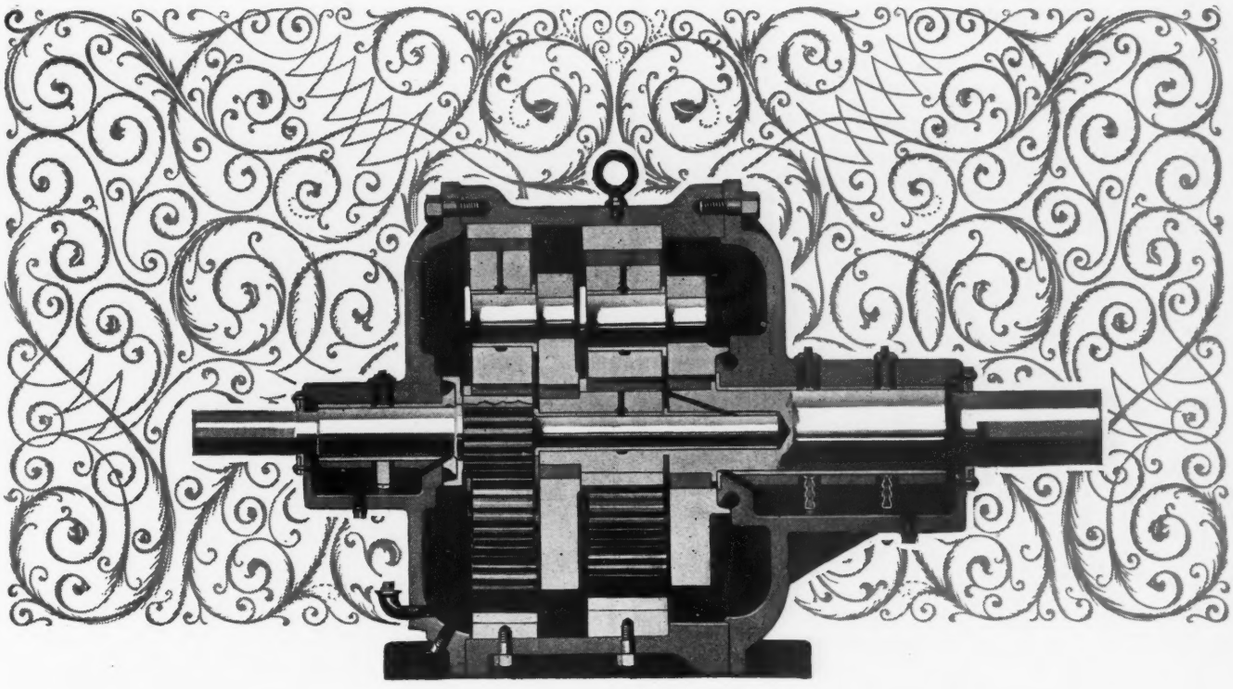
ROLLER THRUST BEARINGS



STANDARD DIMENSIONS
or to ORDER, up to 12" Shaft Dia.
One—or one thousand
The Gwilliam Company
23 Flatbush Ave., Brooklyn, N. Y.

HIGH DUTY Magnetic Separators

Magnetic Separators for reclaiming waste material, for concentrating and refining non-ferrous metals.
MAGNETIC CLUTCHES FOR DRIVES
MAGNETIC MFG. CO., 276 24th Ave., MILWAUKEE, WIS.



The Advantages of James Design

THE James Speed Reducing Transmission combines a number of advantages that are peculiar to its design.

We not only obtain much higher ratios of reduction in a given space, and with less gears than are possible with other types, but the forces that are a distinct disadvantage in ordinary spur gear assemblies are utilized to produce a more efficient and smoothly operating unit.

All gears are always in mesh and all revolve in the same direction, with a rolling tooth contact, eliminating a reversal of power direction at each reduction stage, and setting up an inertia that has the steadying effect of a fly-wheel upon the whole unit.

The intermediate gears are balanced by the opposing forces of the driving pinion and the stationary internal gear, hence it is obvious there are no overhanging strains on the bearings of the intermediate gears of main shaft bearings.

The pinions, turning planetarily within the stationary internal gear, have the greatest possible number of teeth always in mesh, give greater strength and have the decided effect of quiet operation.

The James Speed Reducing Transmission has kept pace with the most advanced engineering, and it constitutes an honestly built, highly efficient unit that may be applied wherever electric motors are used.

The D. O. James Manufacturing Co.

1114 W. Monroe St., Chicago, Ill.

Manufacturers also of

Spur, Bevel, Mitre, Worm, Internal, Helical and Tractor Gears.
Rawhide and Bakelite Pinions—Racks.

22

D.O.JAMES

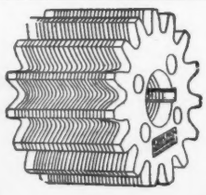
GRANT GEARS

Made in any quantity, from single experimental gears or rush breakdown repair, to production orders; in all sizes from ¼″ to 72″.

Ask for latest catalogue

GRANT GEAR WORKS

151 PEARL STREET, BOSTON, MASS.



Gears, Mallets from Tough

"Chicago Rawhide"

Here you have the toughest and most durable in Gears and Mallets—two "Chicago Rawhide" products.

"Chicago Rawhide" Gears and Gear Blanks are elastic, noiseless, long-lived, economical and strong.

Our "Chicago Rawhide" Mallets and Hide-Faced Hammers are non-conductors—they can't damage fine surfaces or soft metal work—just what you've been looking for. We also make Belting, Lace Leather, Cut Lacing, Hydraulic Packing.

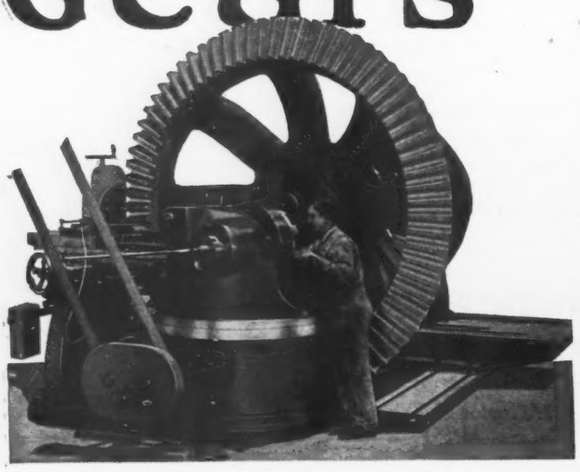
Write us for complete catalogue

The Chicago Rawhide Manufacturing Co.

1309 Elston Avenue Chicago, Ill., U. S. A.

Branch: 109 Broad St., New York
New England Branch:
Lewis E. Tracy Co., 127 Broad St., Boston

Earle Gears



High grade big gears; accurate, long-wearing, economical; they add to the efficiency of big machines.

Get an estimate.

The Earle Gear & Machine Company

4707-15 Stenton Ave. Philadelphia

GEARS

Bevel— to 8″	Worm Wheels to 8″	Spiral or
Spur— to 12″	Worms and Racks	Helical to 12″

Made up in any material required.

Perkins Appliance Company

Springfield, Mass.

Specialists on Small Gears

No gears over 4″ diameter, but anything you want that's less than that. If you need small gears, *any kind*, get an estimate.

Meisselbach-Catucci Mfg. Company

54 Stanton St.

NEWARK, N. J.

Service!

Service—in connection with gears the word "Service" is immediately coupled with Phillie Gear, and Phillie Gear brings to mind the place where any conceivable kind of a gear can be obtained *when*, *how* and *where* you want it; and Phillie Gears' Gears give *service*. The word to Phillie Gear means more than getting the order delivered on time, it means a gear or speed reducing unit which is *right*, material and workmanship; the *word* to Phillie, means all that it implies.

Phillie Gear's *service* means gears of every *kind*, every *size*, to order or from stock. Immediate shipment from stock and quick shipment if it must be made up.

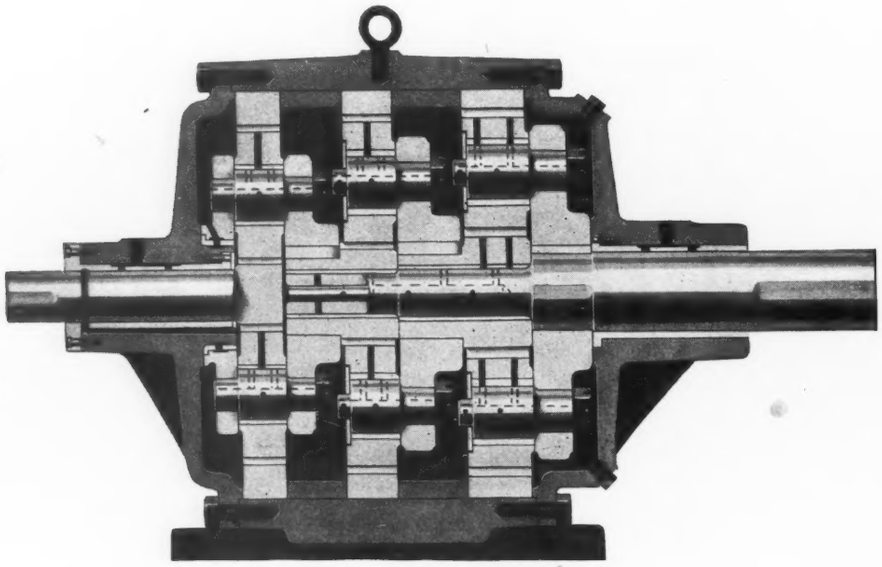
Tell Phillie Gear your gear troubles and you're through with them for life.

MEMBER OF AGMA

"A Badge of Merit"

Philadelphia GEAR Works 1120-1128 Vine St. Philadelphia

New York Sales and Engineering Offices:
50 Church Street



Ganschow Type "A"—Triple Speed Transformer

Something About Design

Ganschow Spur Gear Speed Transformers are designed to give the greatest reduction in a minimum space and with a maximum of strength.

The whole rotating mechanism revolves—in one direction—inside the internal gears which are securely keyed in the housing.

All the forces of motion are equally distributed and advantageously used in securing highest efficiency.

The gear design is not only compact, but because of the use of internal gears, secures the engagement of a maximum number of teeth, and hence greater strength.

Each stage of reduction revolves independently on a wide bearing of its own and by means of an annular bearing on the inside hub of the high speed end, a perfect axial alignment is secured, reducing overhanging load to a minimum and eliminating all tendency toward the springing of shafts and the consequent binding in bearings.

The lubrication of these units is ideal. The main shaft bearings are lubricated directly by oil cups, and each bearing of the interior rotor is equipped with duplex oiling ducts, one set delivering oil from the reservoir through hollow shafts and trunnions, and the other supplying it through ducts in the gears themselves.

Our bulletin No. 101 explains these distinct Ganschow advantages more fully. We will be glad to send it upon request.

William Ganschow Company

16 N. MORGAN ST.
CHICAGO :: ILLINOIS

MEMBER OF AGMA

Manufacturers of
CUT GEARS AND
SPEED TRANSFORMERS

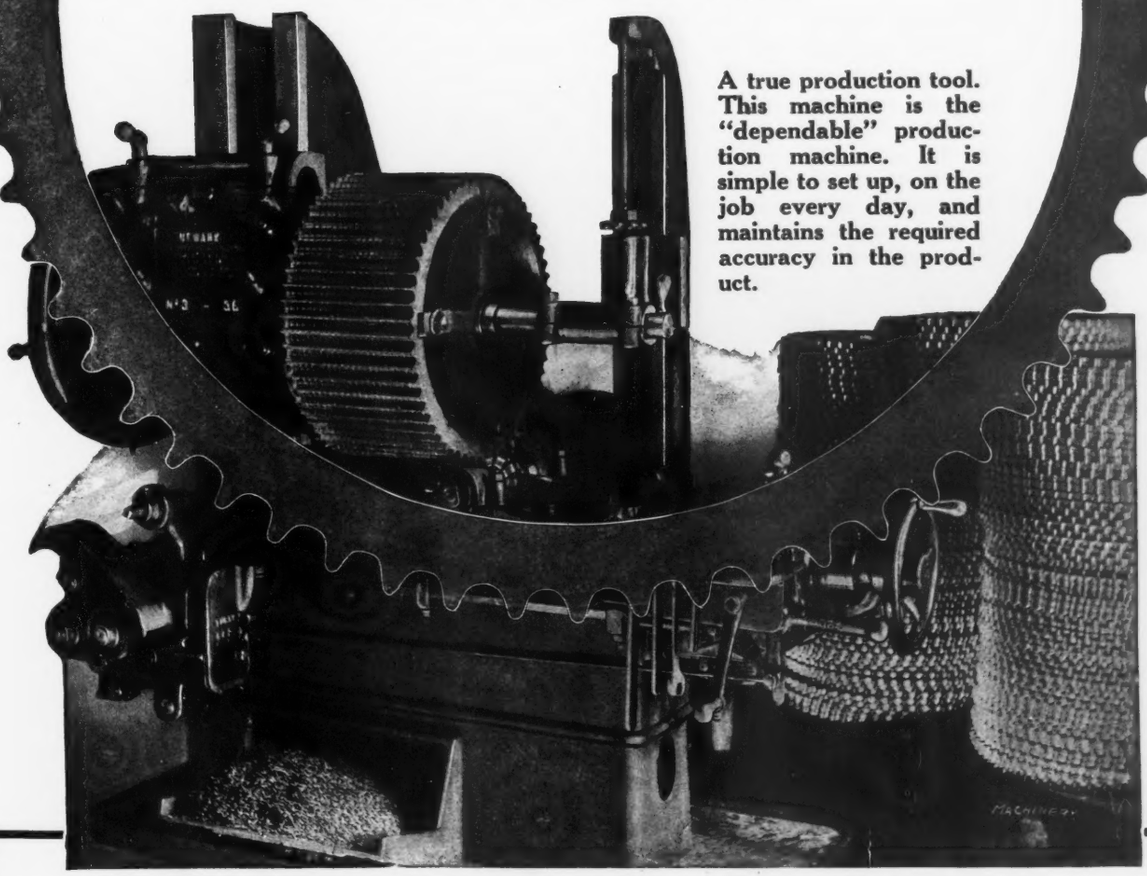
115

GANSCHOW

60 Teeth—6 Minutes

60 Teeth, 1" Circular Pitch
Semi-steel Sprockets
19½ Inches Diameter
15/32" Thick

Cut in gangs of twenty-two at a time on the arbor. This makes a cut of 10½" total face. This is the full capacity of the machine, a NEWARK No. 3 Automatic Spur Gear Cutting Machine, and this rugged machine cuts these sprockets at the rate of 6 minutes per sprocket.

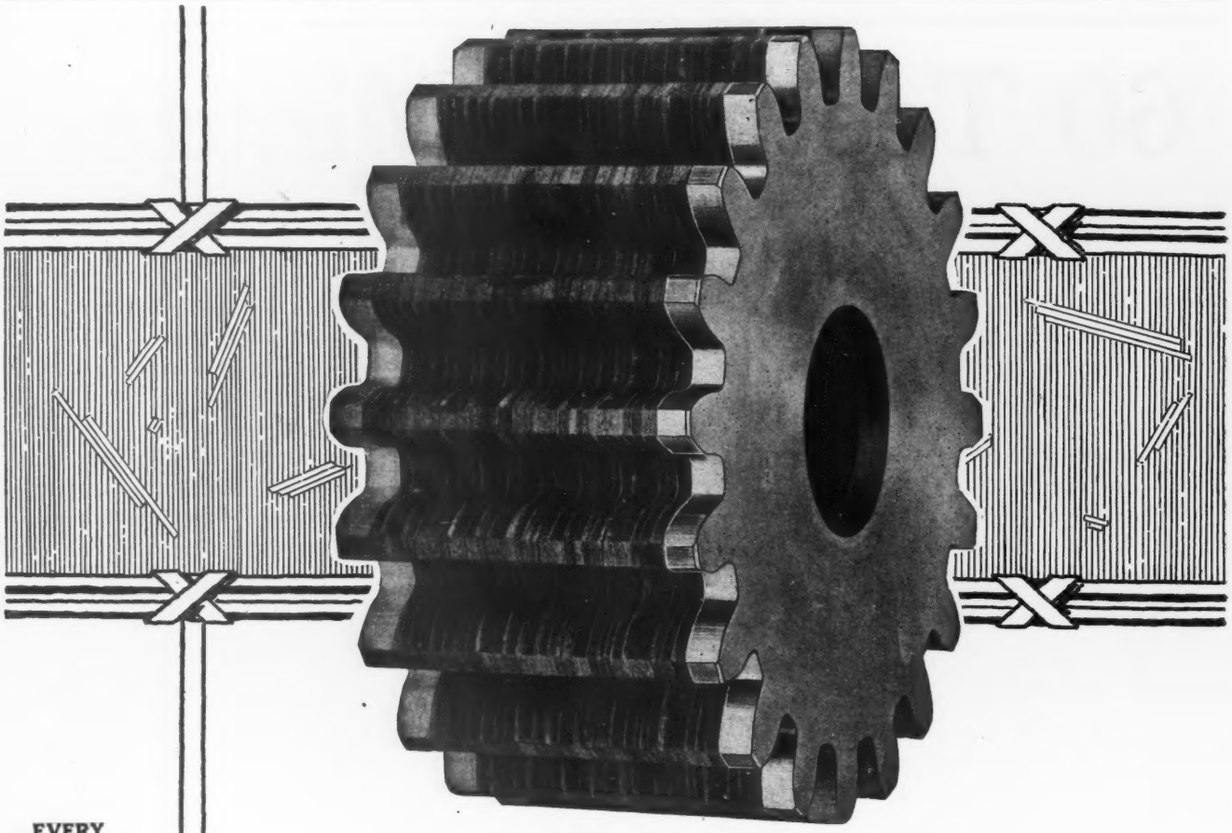


A true production tool. This machine is the "dependable" production machine. It is simple to set up, on the job every day, and maintains the required accuracy in the product.

Newark Gear Cutting Machine Co.

HENRY E. EBERHARDT, President

NEWARK, NEW JERSEY, U. S. A.



EVERY INDUSTRIAL GEAR

BEVEL
SPUR
SPIRAL
HERRINGBONE
WORM

SPEED REDUCERS

RAWHIDE-BAKELITE PINIONS

HARDENED HEAT-TREATED GEARS

Why We Trebled

To meet the demands of satisfied buyers we recently trebled our floor space by constructing a new plant addition. Thirty-six years of gear making are behind what we offer the trade.

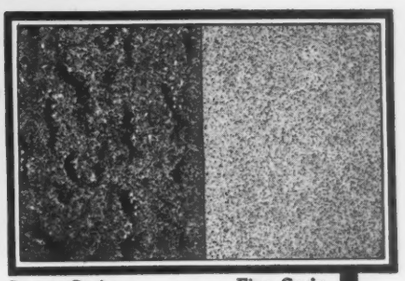
In this period of machinery and equipment overhauling or redesigning, you probably have need of product we can supply from our large stock of patterns. For dependable service on reduction or other gears write us.

The Horsburgh & Scott Co.

Cleveland, Ohio

MEMBER OF AGMA

MEMBER OF AGMA

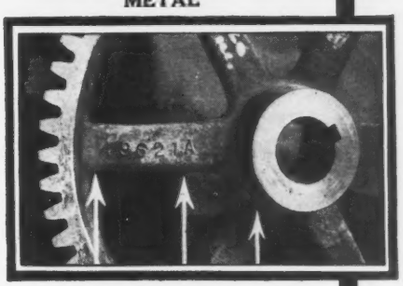


Coarse Grain Fine Grain
FOOTE GEARS ARE MADE OF SELECTED FINE GRAINED METAL

DON'T LET INFERIOR GEARS STOP YOUR PRODUCTION

FOOTE IXL GEARS

are Gears of known Superior Quality



FULL WEIGHT AT HUBS, SPOKES AND RIMS

The risks of delay in production are reduced to a minimum when you use FOOTE IXL GEARS. The quality of metal is tested in order to know that the metal is uniform and of proper close grain. No coarse grained metal is used in IXL Gears.

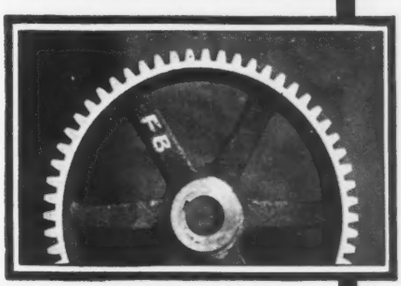
The gear blanks are full weight and are correctly reinforced at all points—no skimping at hubs, spokes and rims.

The cutting is carefully and accurately done.

The finished product is carefully inspected.

The greatest speed in delivery consistent with proper workmanship is our constant endeavor.

When you use FOOTE IXL GEARS you are taking every precaution against production delays. Send for IXL gear Data Book.



ACCURATELY CUT

CAREFULLY INSPECTED

FOOTE BROS. GEAR & MACHINE COMPANY

232-242 N. Curtis Street, Chicago, Illinois

New York Sales Office: 100 Greenwich St.

1306 Keenan Bldg., Pittsburgh, Pa.

840 Brown-Marx Bldg., Birmingham, Ala.

Jackson Bldg., Buffalo, N. Y.

King-Knight Co., Bradbury Bldg., Los Angeles, Cal.

King-Knight Co., Seattle, Wash.

King-Knight Co., Portland, Ore.

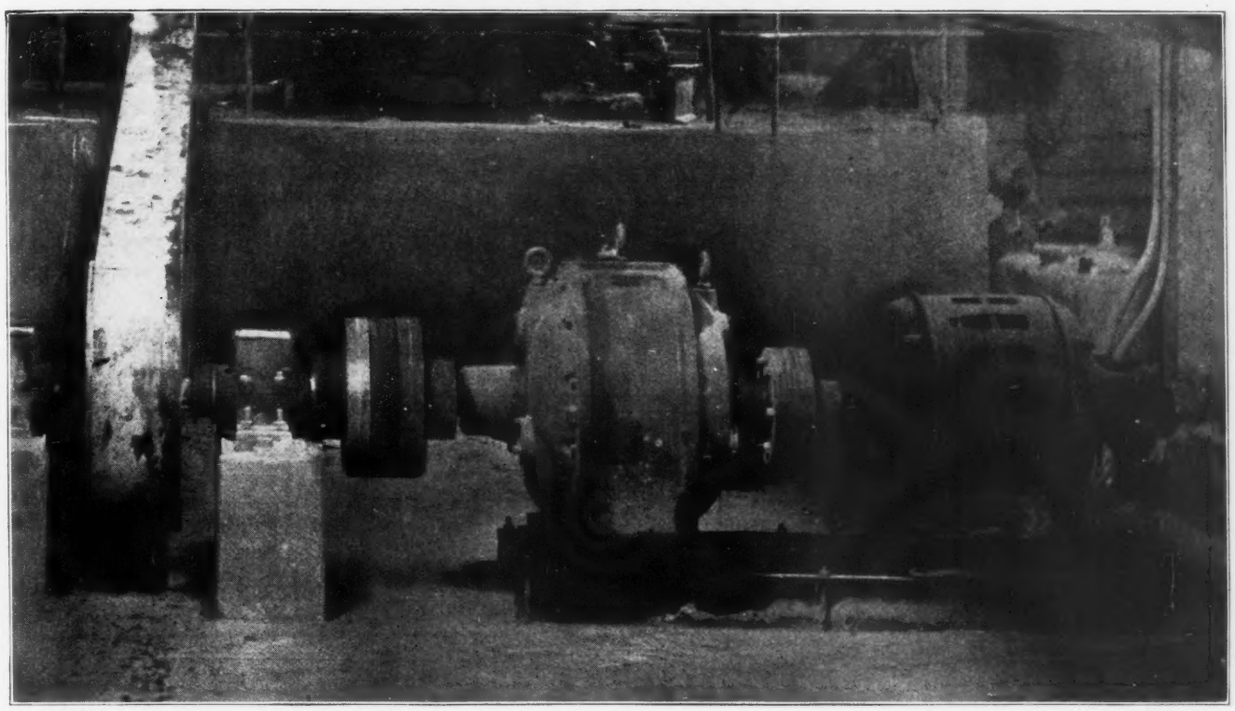
GLEASON
SPIRAL BEVEL GEARS
Quiet, Smooth and Efficient in Action

Spiral Bevel Gears are not restricted to any one service in the mechanical field, their use is constantly broadening in scope.

If your problems include the positive transmission of power quietly, smoothly, and efficiently, at high speeds, for any duty, the Spiral Bevel Gear merits your consideration.

GLEASON WORKS
ROCHESTER, N. Y.

Manufacturers of Gears and Bevel Gear Cutting Machinery



Jones Speed Reducer driving Kilns in a Cement Mill. Motor speed 720 R.P.M. Final Speed, 240 R.P.M.—ratio 3 to 1

Speed Reduction— and Cost Reduction

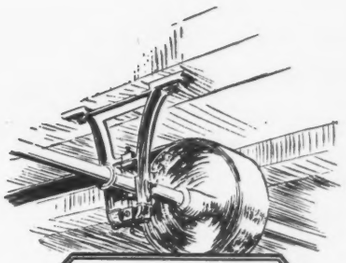
The design of Jones Speed Reducers—fully enclosed—gives assurance of proper lubrication, protection from dirt, dust and moisture, ***uninterrupted service to the job.***

You know what that means in keeping up production volume and in the holding down of production costs.

Add to those features, the elimination of the accident hazard to workmen, always a factor when old-fashioned exposed belts, pulleys, gears and chains are used for the purpose of speed reduction.

Add to that safety to man and machine, economy of floor space; a speed reduction that is accomplished with the minimum loss of power; a neat, compact unit that is built to endure—and you have the Jones Speed Reducer.

Send for Catalogue No. 26, the authoritative guide to modern practice in the application of motor drive speeds to the operation of comparatively low speed machines.



Power Transmission Service

IN addition to spur and worm gear speed reducers, we manufacture a complete line of power transmission appliances—hangers, pulleys, couplings, pillow blocks, friction clutches, ball-bearing loose pulleys, safety collars, etc.

The service of our engineers is at your command. Their experience may prove very helpful. We will be glad to have you write us.

W. A. Jones Foundry & Machine Company

Main Offices and Works: 4409 West Roosevelt Road, Chicago

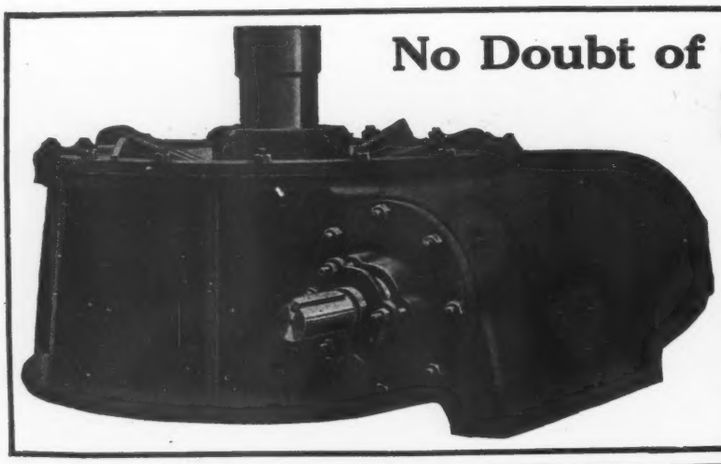
Branch Sales and Engineering Offices:

New York	Pittsburgh	Cleveland	Buffalo
Church and Murray Sts.	Union Trust Bldg.	226 Superior Ave. N. W.	45 Pearl St.

Milwaukee	Detroit
425 E. Water St.	137 E. Woodbridge St.

Jones Speed Reducers

and Power Transmitting Machinery



No Doubt of the Service from Hindley Gears

If there was any question as to the service Hindley Gears render they wouldn't be found in so many large engine lathes, in the steering mechanism of large vessels, on mine hoists, railroad turn tables, etc., where stresses are great and where unfailing service may be a matter of life and death.

Worms, spirals, specials, for your most important drives. Send for catalog.

HINDLEY GEAR COMPANY
1105 Frankford Ave. -Philadelphia, Pa.

ALLING-LANDER *for Good Gears*

The simplest and least expensive gear we make upholds the Alling-Lander reputation for good gears. Fine finish and unusual accuracy assure smooth operation, power economy and long life.

We are well equipped to supply your needs for Spur Gears, Worm Gears, Worm Gear Reduction Units and Special Gears.

Quick delivery and reasonable prices—let us quote.

Consistent Quality

ALLING-LANDER COMPANY, Inc.
SODUS, N. Y.

Precision Gears

Small and medium size gears in all types and materials. Specialization guarantees quality at moderate costs. Let us estimate.

Massachusetts Gear & Tool Co.
34 Nashua Street, Woburn, Mass.

HERRINGBONE CUT GEARS

MILL DRIVES — SPEED REDUCERS — FAWCUS — SPUR WORM BEVEL GEARS

FAWCUS MACHINE CO. PITTSBURGH, PA.

BEVEL GEAR GENERATORS
BEVEL GEARS

CUT THEORETICALLY CORRECT

Special facilities for cutting Worm, Helical, Miter, Internal and Elliptical Gear Wheels.

The Bilgram Machine Works
1231 Spring Garden Street, Philadelphia, Pa.

"Zones of Quiet"

AD

Albaugh-Dover accurately Generated Gears are used by many of America's leading manufacturers of Automobiles, Trucks, Tractors and other machinery. If you use gears—Spiral, Helical, Internal—Worm or Worm Wheels, send us your blueprints or sample gears for estimates.

ALBAUGH-DOVER MFG. CO.
2100 Marshall Blvd. Chicago, Ill.

GEARS

A Trial Order is Proof

A trial order of **Meisel Gears** will prove to you that the many well-known manufacturers who choose them for their equipment use shrewd, far sighted judgment.

Meisel Gears are strong and durable, accurately cut, mesh correctly, are of the highest possible quality and give the longest possible service.

TRY THEM.

Meisel Press Mfg. Co.
948 Dorchester Avenue,
Boston, 25, Mass.

INSIST UPON THIS TRADEMARK ON EVERY HERRINGBONE GEAR YOU BUY

CONTINUOUS TEETH—
SHARP APEX POINTS

FINEST MATERIALS USED
—BEST WORKMANSHIP

THIS TRADEMARK GUARANTEES THAT GEARS ARE GENERATED ON SYKES MACHINES

THE GEAR WITH A BACKBONE

FARREL FOUNDRY & MACHINE CO., INC.

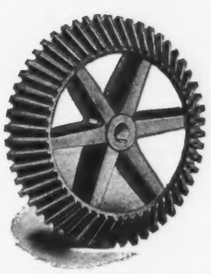
BUFFALO, N. Y., U. S. A.

NEW YORK CITY — CLEVELAND, OHIO — BOSTON, MASS.
SAN FRANCISCO, CAL. — HAVANA, CUBA — LOS ANGELES, CAL.

Plants Located at BUFFALO, N. Y., ANSONIA, CONN.

Gear Manufacturers Since 1843

During these many years we have perfected the gear molding process, developed and built the machines and accumulated an actual stock of 16,000 patterns. Our facilities and our experience enable us to make high grade gears quickly and economically. Let us show you.



Catalog?

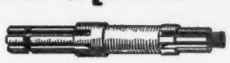
POOLE ENGINEERING & MACHINE CO.
BALTIMORE, MD.

CONNECTICUT GEARS

INCORPORATED 1921

3 P or finer bevel gears 24" or smaller
4 P or finer spur or worm gears 36" or smaller
10 P or finer helical, spiral, herringbone 8" or smaller
152 Pearl Street, WATERBURY, Conn.
May we quote? *Formica?*

Cut Gears and Splined Shafts



Heat Treating and Carbonizing

THE MACHINE PRODUCTS CO.
17900 ST. CLAIR AVE. CLEVELAND, O.

STAHL GEARS

We specialize in the sizes listed below and guarantee your entire satisfaction.

Remember—specialization pays! Try Stahl Gears.

Metal gears—spurs up to 65" dia., 1¼ D.P.; bevels up to 37" dia., 1¼ D.P.; spirals and herringbone gears up to 19" dia., 3 D.P.; worm gears up to 18" dia., 3 D.P.; racks 8' long, 3 D.P. Rawhide gears—any requirement up to 15" dia. 2 D.P.

We also manufacture Formica Pinions

MEMBER OF AGMA

The Stahl Gear & Machine Company
1390 East 40th Street Cleveland, Ohio, U. S. A.

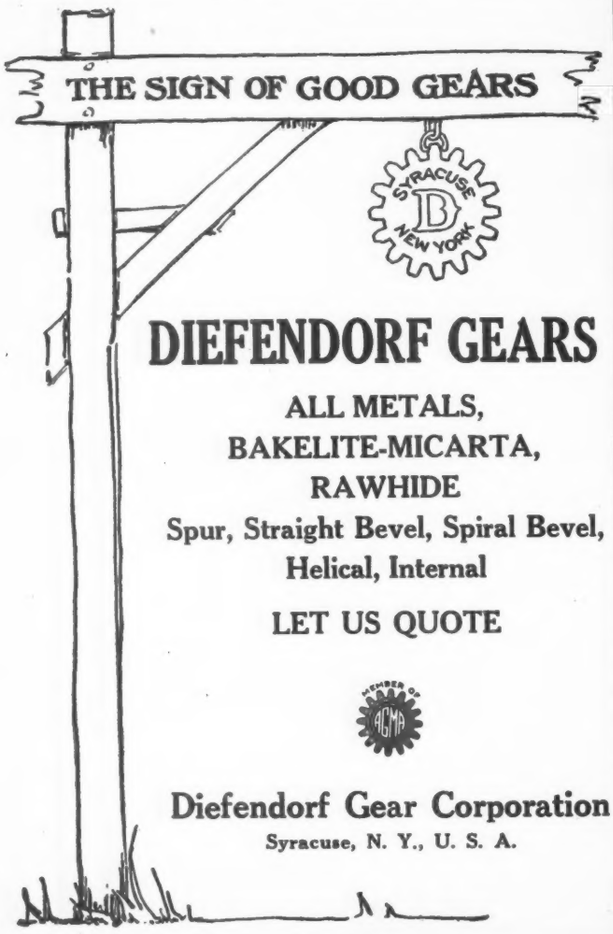
Gears to Order—

Cincinnati Gears insure the efficiency of machine driving mechanisms. They are accurate, durable—made of the correct materials for each drive, and the *price is right.* Send blueprints for estimate.

Good Deliveries!

The Cincinnati Gear Company

1825-1841 Reading Road, CINCINNATI, OHIO



DIEFENDORF GEARS

ALL METALS,
BAKELITE-MICARTA,
RAWHIDE
Spur, Straight Bevel, Spiral Bevel,
Helical, Internal

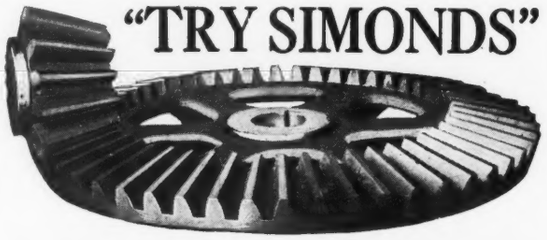
LET US QUOTE

MEMBER OF AGMA

Diefendorf Gear Corporation

Syracuse, N. Y., U. S. A.

"TRY SIMONDS"



MEMBER OF AGMA

Cut Gears, Racks, Worms, Worm Gears, Bakelite-Micarta, Special Machinery

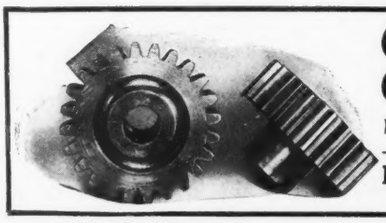
Write

THE SIMONDS MFG. CO., Pittsburgh, Pa.

Adams-Farwell GEAR HOBBERS

Write for Catalog No. 809

THE ADAMS COMPANY 1910 Market Street Dubuque, Iowa, U. S. A.



Gears and Gear Cutting

We guarantee satisfaction

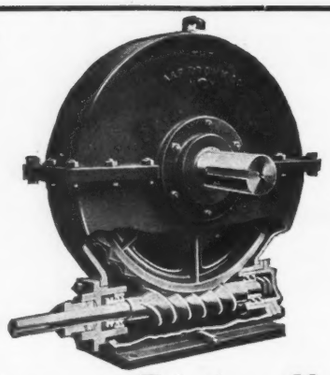
RODNEY DAVIS
PHILADELPHIA, PA.

SPEED REDUCER Long-lead, multiple thread worm

The worm and worm wheel is a very old speed reducing device and as formerly made only adaptable to light loads and slow speeds.

The long-lead multiple thread worm and corresponding wheel as more lately developed has overcome the objection to this form of speed reducer, and so increased its efficiency that it is now recognized as a most economical method of reducing speed with a minimum loss of power. *Noiseless, No Vibration, Durability, Safety.*

Spur Gear Speed Reducers, Change Speed Gears, Bevel Gear Transmission in Oil Tight, Dust Proof Cases.



GEARS—

Of Steel, Semi Steel, Cast Iron, Bronze, Rawhide, Bakelite, Condensite, and Fibre for MOTOR, MACHINE, MILL or POWER PLANT

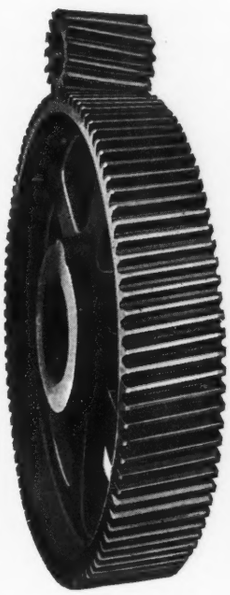
Planed Bevel Gears up to 48 in. diam.

Cut Spur Gears up to 96 in. diam.

Machine Moulded up to 192 in. diam.

Shafting, Pulleys, Hangers, Friction Clutches, Etc.

Works ELIZABETHPORT, N. J. **THE A. & F. BROWN CO.** Engineering and Sales Office 79 BARCLAY ST. NEW YORK



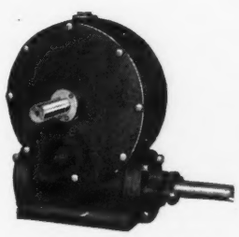
If you were to offer twenty times their price, *nobody* could make you better gears than Nuttall BP Helicals.

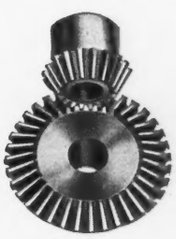
R.D. NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

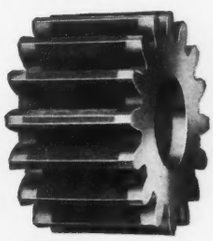
Chicago Office: 2133 Conway Bldg.
Philadelphia Office: 420 Land Title Bldg.

STANDARDIZED
BOSTON GEARS

MILLIONS
IN USE ALL OVER THE UNITED STATES
IS POSITIVE PROOF OF THEIR SUPERIORITY


REDUCTION UNITS
¼ to 3 H.P.


BEVELS
UP TO 15" P.D.


FABROIL PINIONS
8 to 2½ D.P.

SPURS
48 to 2½ D. P.

RENOLD-BOSTON
SILENT CHAIN DRIVES
1 to 30 H.P.

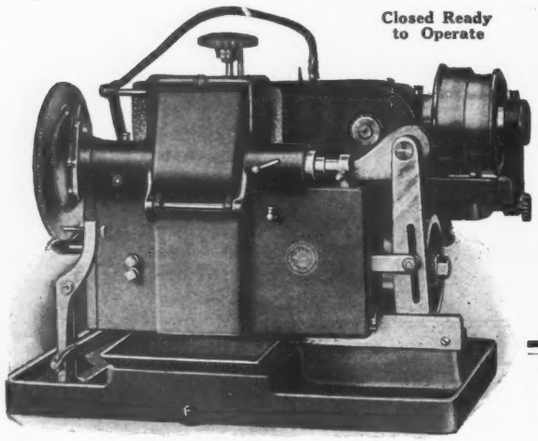
LARGE STOCK AT 20 DISTRIBUTING POINTS

SEND FOR LATEST CATALOG

BOSTON GEAR WORKS
NORFOLK DOWNS, QUINCY, MASS.
BOSTON NEW YORK CLEVELAND CHICAGO

MEMBER OF AGMA

It Makes Small Gears and Pinions



Closed Ready to Operate

The Waltham 4″ Spur Gear Cutter is indispensable wherever clocks, recording devices, typewriters and other mechanisms requiring many small gears and fine pitch pinions are manufactured. This machine is equipped with a sufficient variety of feeds and speeds to perform any operation within its 4-inch range. It is strong, safe and compact.

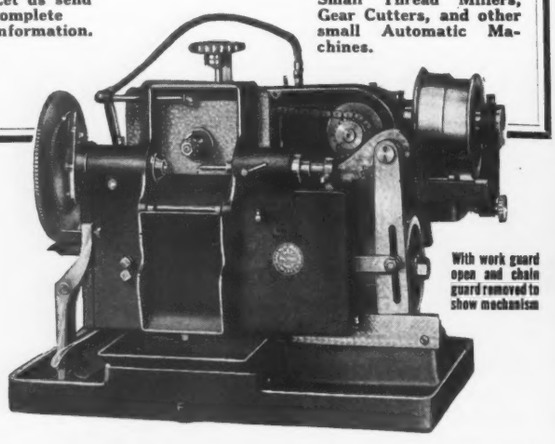
Can be Operated to Advantage in Battery

Cutter and work are entirely enclosed; cutter is operated by silent chain; and once started the whole mechanism runs itself till the last tooth is cut—when the cutter stops with the cutter raised for the insertion of a new blank.

Ball bearings are liberally used throughout, and an individual geared pump provides constant lubrication.

Let us send complete information.

Small Thread Millers, Gear Cutters, and other small Automatic Machines.



With work guard open and chain guard removed to show mechanism

WALTHAM MACHINE WORKS
NEWTON ST., WALTHAM, MASS.

May We Furnish You Your Collets?

We carry an extensive stock.

You cannot equal our quality—our exactness, neither can you approach our price because we have constant production on this one item—furnishing them to the largest and most exacting users of collets in this country.

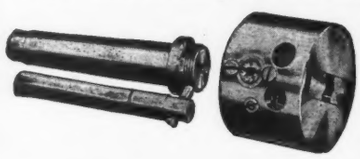
Checking up the above statements cannot cost you anything.

What sizes do you use?

Rivett
LATHE AND GRINDER CORPORATION
BRIGHTON DISTRICT OF BOSTON MASS

The old masters of the art of toolmaking.

For Economy in Precision Boring



Flynn Micrometer Off-Set Boring Heads

Think of the convenience and the time you can save on jig, fixture and experimental work by having a boring tool so fixed that you can advance it by thousandths, plainly indicated on an easily read dial, with the same wrench which turns the screws which open and lock the jaws.

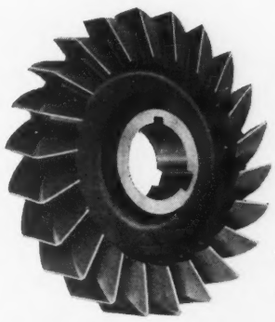
Heads run concentric with minimum overhang and no projections to interfere in close quarters.

Let us tell you more about it.

J. M. WATERSTON 425 Woodward Ave. DETROIT, MICH.

Special Tools **COWLES CUTTERS** Special Tools
Milling Cutters for Every Job
COWLES TOOL COMPANY
Cleveland, Ohio : U. S. A.

ALBRO-CLEM
HINDLEY GEARING
WILL DO THE WORK
When Common Worm Gearing Fails
ATLANTIC ELEVATOR CO., Inc.
ALBRO-CLEM WORKS
500 Erie Ave., East, Philadelphia, Pa.



Tools that Go and Go

MADE IN

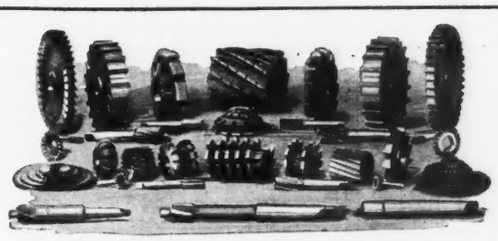
DETROIT. MICH. U.S.A.

TRADE MARK. REG U S PAT OFF

GODDARD & GODDARD COMPANY

DETROIT

MILLING CUTTER ENGINEERS



NATIONAL CLEVELAND

"Extra Service" Tools

Milling Cutters, Spur and Worm Gear Hobs, Reamers, Interchangeable Counterbores, Special Tools.

The National Tool Co., Cleveland, Ohio

New York, 126 Chambers St.; Philadelphia, Sedgley at Dauphin St.; Chicago, 624 Madison Terminal Bldg., 9 So. Clinton St.; Detroit, 400 Marquette Bldg.; Pittsburgh, 814 Bessemer Bldg.; Cincinnati, 141 E. 4th St.; Atlanta, Ga., 34 So. Forsyth St.

TAPS and DIES

REGISTERED TRADE-MARK V C

The Famous "Carpenter Quality"

Precise Uniform Durable

J. M. Carpenter Tap and Die Company

Oldest Tap and Die Makers in America

Pawtucket Rhode Island

THE SOMMER & ADAMS CO.

18511 Euclid Avenue -:- -:- Cleveland, Ohio

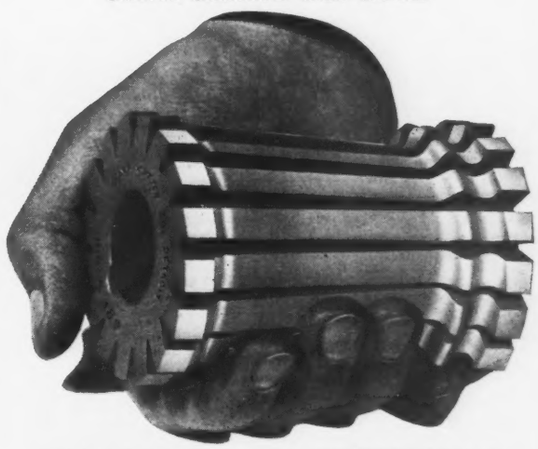
SOMMER & ADAMS COMPANY SA CLEVELAND

CUTTERS OF ALL KINDS

MULTIPLE SPINDLE HOBBERS

HORIZONTAL BORING, DRILLING AND MILLING MACHINES

"Clark Cutters Cut Costs"



FORM CUTTERS

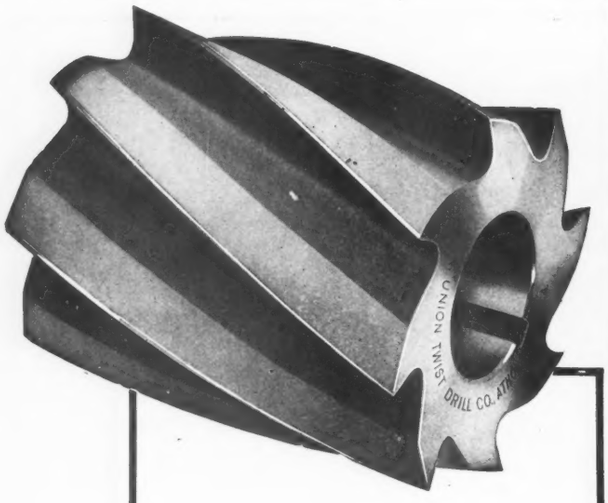
Hobs Milling Cutters

CCO

Accurately made of the best high-speed steel and carefully heat-treated to meet the demands of maximum production.

Clark Cutter Company

1304 Harper Avenue DETROIT, MICH.



Save on Cutter Costs

Union Drills and Union High Power Under Cutters *bite* into metal instead of nibbling at it. It's the unique "in curve" on the drill flutes and cutter teeth that does it —that speeds production and makes the cutting edges give longer, more efficient service.

Another advantage that saves time when regrinding is necessary, is the wide spacing of the teeth of Union High Power Cutters—teeth are more than twice as far apart, in many cases, than in other cutters.

Let us show you how to make a saving in the cost of cutters.

Union Twist Drill Co.
Athol, Massachusetts

now!
is a good time

Now, while business is quiet, is a good time to make necessary repairs.

Perhaps the most important ones are repairs to your bearings, because a machine is only as strong as its moving parts.

Reline all your bearings with

Ajax Bull Bearing Alloy

It's made from virgin metals by the Ajax Alloying Process and is guaranteed to wear longer and to run cooler than babbitt.

THE AJAX METAL COMPANY
ESTABLISHED 1880
PHILADELPHIA
NEW YORK CHICAGO BOSTON CLEVELAND

BUY YOUR COLD DRAWN STEEL SCREW STOCK FROM MOLTRUP

Cold Drawn Bessemer—Free cutting for high speed work. Case hardens nicely. For screws, bolts, nuts, etc.

Cold Drawn Open Hearth for super-quality screw parts.

Immediate Delivery. Send for Prices.

Moltrup Steel Products Co.
Beaver Falls, Penna., U. S. A.

DISTRICT OFFICES: New York, Woolworth Bldg.; Boston, 80 Boylston St.; Philadelphia, 789 Drexel Bldg.; Buffalo, 303 White Bldg.; Portland, Ore., 421 Stark St. SALES AGENCIES: Central Steel & Wire Co., Chicago and Detroit; H. D. Cushman Company, Cleveland; R. E. Murray & Co., 308 McKevitt Bldg., Norfolk, Va.; Union Iron & Steel Co., Cincinnati.

BY INVITATION MEMBER OF
NEW YORK, U.S.A.

VULCANIZED FIBRE

BE SURE AND SPECIFY

"WILMINGTON FIBRE"
SHEETS RODS TUBES WASHERS, Etc. SPECIALTIES

WILMINGTON FIBRE SPECIALTY CO., Wilmington, Del.
BRANCH OFFICES "EVERYWHERE"

120 POUNDS OF AIR PRESSURE

BEHIND RIVET SNAPS HELPED ESTABLISH
THE REPUTATION OF

FIRTH-STERLING SPECIAL
TOOL AND DIE STEEL

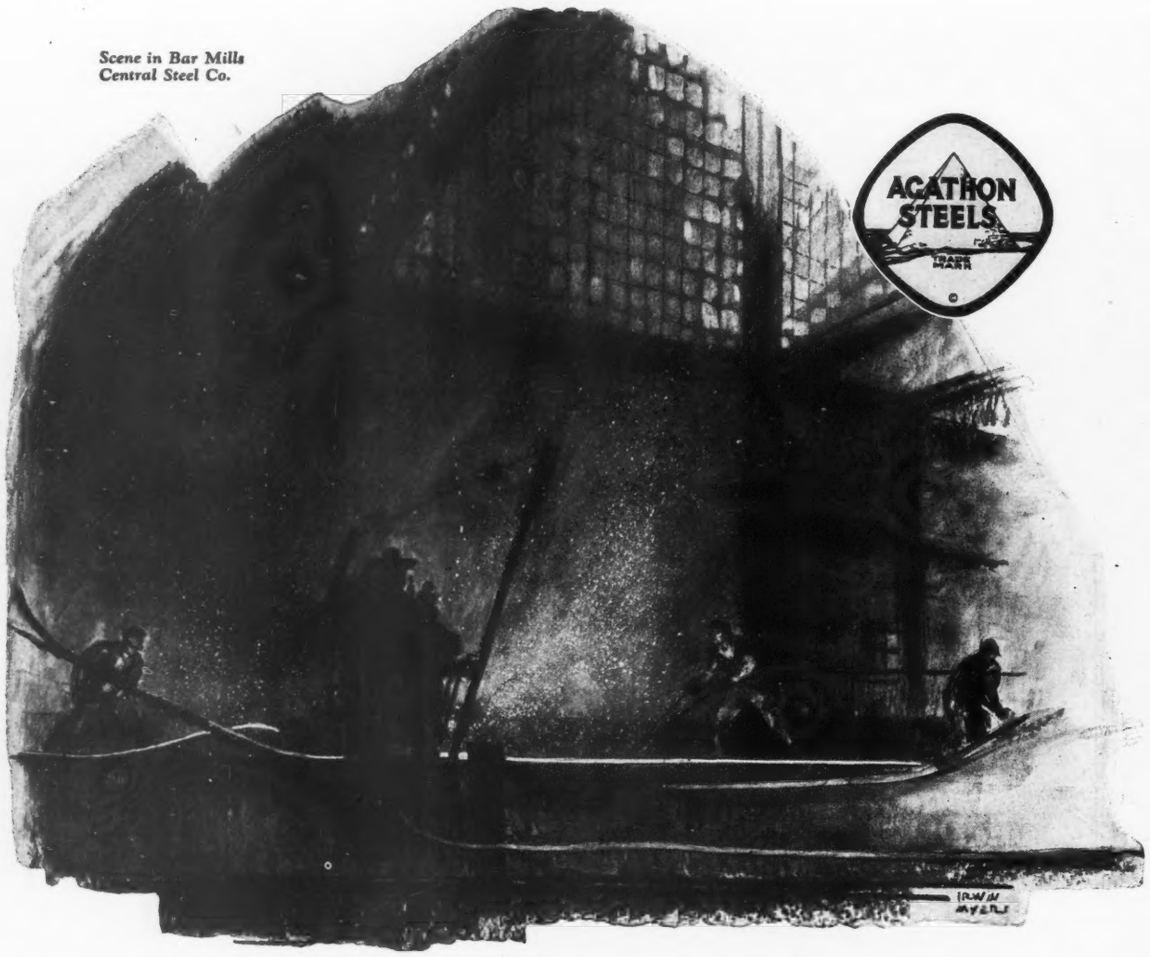
BEFORE the late war Firth-Sterling Special Steel for rivet snaps was favorably known and used in many parts of the country because of its wearing qualities and the freedom from breakage which was always a shop problem, even though the air pressure used in the riveting was only about eighty pounds per square inch. During the war the enormously increased requirements called for more rapid riveting and in many shops the air pressure was increased to one hundred and twenty pounds per square inch, with the result that rivet snaps of the weaker steels failed through rapid wear or breakage soon after being put to work.

Snaps made from Firth-Sterling Special Steel stood the test

FIRTH-STERLING
STEEL COMPANY

McKeesport, Pa.

NEW YORK BOSTON HARTFORD
PHILADELPHIA CHICAGO CLEVELAND
DETROIT SAN FRANCISCO LOS ANGELES



Scene in Bar Mills
Central Steel Co.

We Will Solve Your Problem in Steel

PROBLEMS in steel arise in the experience of every manufacturer of metal products having parts subjected to heavy wear or great stresses and strains. Often the success of the product is dependent upon the wise selection of steel for its various parts. Where extraordinary strength, toughness, ductility or hardness is required, some kind of alloy steel must be used.

But what analysis of steel will best meet your requirements? What heat treatment would be necessary? How will you select the proper steel? Perhaps you are not familiar with the characteristics of various steels. You know guesswork is dangerous. Many manufacturers in such predicaments have referred their steel problems to our experienced metallurgists and practical steel men. They solved them successfully in our modern, extensive laboratories without charge. They will do the same for you. Write us.

We have a daily production in all kinds of Agathon Alloy Steels such as—

Nickel, Chrome-Nickel, Uma, Molybdenum, Chrome-Molybdenum, Nickel-Molybdenum, Vanadium, Chrome-Vanadium, Chromium, etc.

Deliveries in Blooms, Billets, Slabs, Bars, Hot Rolled Strips, etc.

THE CENTRAL STEEL COMPANY, Massillon, Ohio

SWETLAND BLDG. CLEVELAND | BOOK BLDG. DETROIT | PEOPLES GAS BLDG. CHICAGO | UNIVERSITY BLOCK SYRACUSE | WIDENER BLDG. PHILADELPHIA

AGATHON ALLOY STEELS

UNION DRAWN STEEL CO.

BEAVER FALLS PENNA

Warehouses

NEW YORK PHILADELPHIA
CHICAGO CINCINNATI
DETROIT

Sales Offices

BOSTON CLEVELAND
BUFFALO
MILTON PRAY CO.
LOS ANGELES SEATTLE
SAN FRANCISCO

Mills

BEAVER FALLS, PA.
GARY, IND.

These facilities are for your convenience

Locomotive Taper Reamers with Coarse Flutes

A new Brubaker tool for the railroad shop. Ample chip clearance and free cutting qualities make these tools as efficient in their line as all other Brubaker products.

Brubaker is a name that stands for satisfaction in the railroad shop, and in industrial machine shops of all classes. A name that is a safe recommendation on which to buy small tools—and a guarantee of the quality of this new reamer.

Write for new inserts for catalog number 6, pages 38A to 41A inclusive, showing sizes and prices of these tools. We also manufacture other types of reamers, taps and dies.

W. L. Brubaker & Bros. Co.
Factory: MILLERSBURG, PA.

Sales Office:
50 Church St., New York, N. Y.

BRUBAKER

COGSDILL MANUFACTURING CO.

DETROIT, MICHIGAN

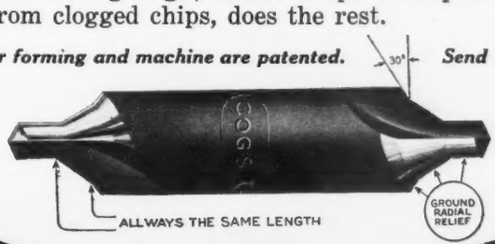
Accurate Center Holes, Big Output, Low Tool Costs

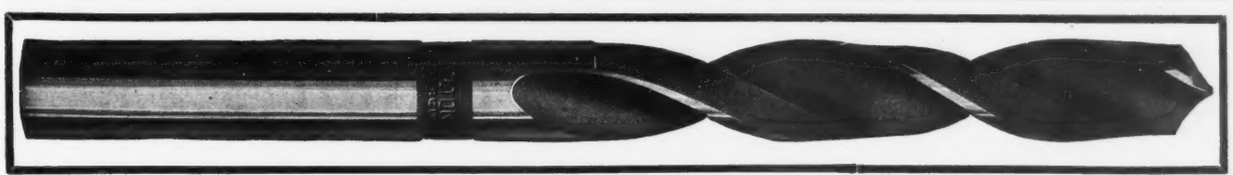
Clean, true center holes insure accurate diameters, reduce wear and tear on machines and save time in machining.

Cogsdrill Center-Drills insure uniformly clean, true countersunk holes; they reduce tool breakage, save centers, save machine time and labor.

Grinding the radial relief *after* hardening is half the secret—insures a true and durable cutting edge; and the spiral chip chute, eliminating tool breakage from clogged chips, does the rest.

Methods for forming and machine are patented. ***Send for catalog.***





For cuts you've never dared before, try

COLTON-DETROIT HIGH SPEED TWIST DRILLS

What good are your heavy-duty drilling machines if your drills can't stand the pace they set? A drilling machine is as productive as the drill will allow it—and no more.

It's evident that a precious lot of energy is lying dormant in many heavy-duty and high-speed drilling machines, simply because the drills won't let the machines give their best.

Well then; here's a tip: Try Colton-Detroit High Speed Twist Drills. Put speed and feed a notch higher than usual. Give the coolant something to do.

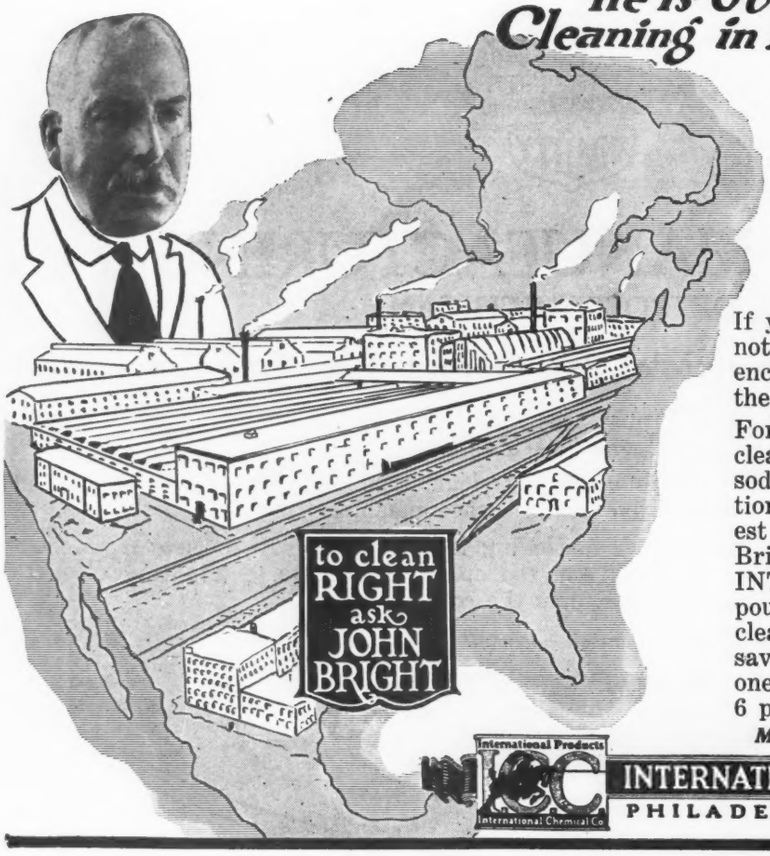
The Colton Drill will *like* it. (And so will your Production Department!)

Special Forging and Finishing does it; makes Colton-Detroit Twist Drills worthy to be called "High-Speed" Drills. Wide grooves prevent clogging. Oversize shanks, if you want them, without extra charge.

Catalog and price list on request.

ARTHUR COLTON CO., 2618 Jefferson Ave., East, Detroit, Mich.

REPRESENTATIVES: **Buffalo:** W. V. Houck, 730 Marine Bank Bldg. **Milwaukee:** General Sales Agency, 3205 Vine St. **New York City:** F. A. Brady, Inc., 30 Church St. **Pittsburgh:** W. E. Nagle & Son, Jenkins Arcade Bldg. **Philadelphia:** Wenson Tool Company, 745 North Sixty-third St. **San Francisco:** L. G. Henes, 75 Fremont Street. **Los Angeles:** L. G. Henes, 218 East Third Street. **Cincinnati:** Advance Tool Co., Canal and Jackson Streets.



He is Over-seeing the Cleaning in Machine Shops all over the Country

His name is John Bright

—a nationally and internationally known character

If your plant is an exception—if you are not taking advantage of this man's experience to secure better and quicker work then read on.

For years a large screw concern had been cleaning all their machined parts in sal soda. Results were good and the production men and P. A. were certain the cheapest method was being followed. John Bright finally convinced them to try INTERNATIONAL No. 22 at 6 cents a pound. Careful testing showed quicker cleaning, better rust prevention and a saving in cost of cleaning material, for one pound of No. 22 did the work of 5 to 6 pounds of sal soda.

May John Bright study your particular problem?

International Products IC International Chemical Co.

INTERNATIONAL CHEMICAL CO.

PHILADELPHIA ----- PENNA.

"For Want of a Nail"

THE SLOCOMB CATALOG IS YOURS FOR THE ASKING.

We all know that old bit about the lost horse shoe nail that caused the loss of an important battle.

How important it is to check up on the little things so that the big achievements which depend on them may go safely forward!

Slocomb Micrometers

have assured accuracy in measurements for more than 25 years. The exceedingly fine reputation of this tool—"The Longest Lived Micrometer that can be bought" is due to the highly tempered tool steel spindle snugly fitted into a removable bushing.

Slocomb Center Drills

are the original center drills which drill and countersink in the same operation. They are made of alloy steel with countersink and drill point ground after hardening and before finish grinding.

Slocomb drilled centers form a perfect bearing, assuring accuracy and preventing burned-out centers.

J. T. SLOCOMB COMPANY, Providence, R. I.

"All Starrett's!"

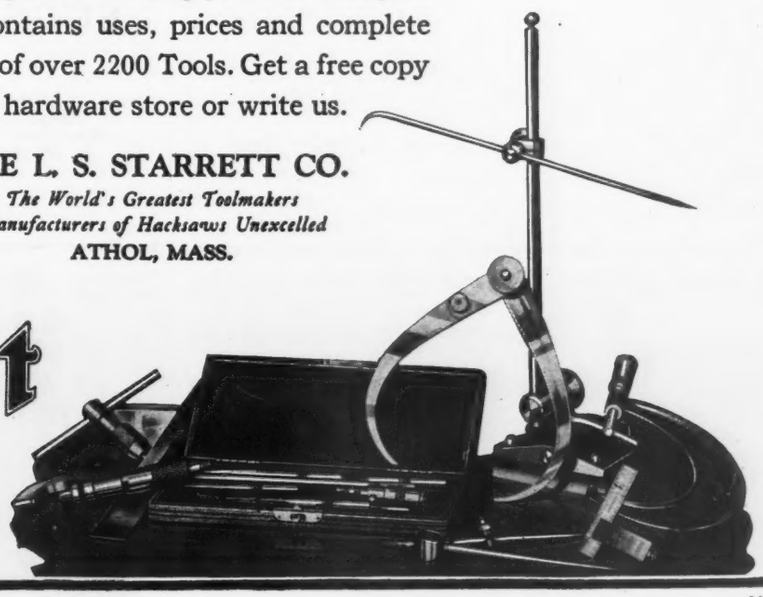
"Boy—you certainly come well recommended."

"Yes—that's what the foreman said when he looked over my kit this morning. And right away he wanted to know how soon I could come to work."

Send for New Starrett Catalog

No. 23 "D" has all the newest additions to the Starrett Line of Fine Precision Tools, Hacksaws and Steel Tapes. It will help you add wisely to your kit—contains uses, prices and complete descriptions of over 2200 Tools. Get a free copy at any good hardware store or write us.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

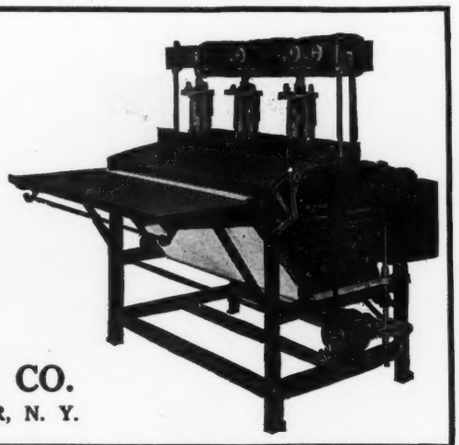


Use Starrett Tools

6026

Speed is Relative—

The most primitive blueprinting machine is faster than a sun frame. We say Paragon Blue Printing Equipment is fast because it works more rapidly than other modern machines. *Perfect prints in four minutes*—by a boy! The book tells how.



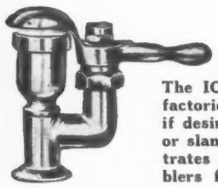
THE PARAGON MACHINE CO.
503 Engineering Bldg. ROCHESTER, N. Y.

Don't Let Neglect Slow Up Production

ICF 200

What is more discouraging to your employees than to be neglected by you? You cannot afford to neglect them this hot weather, when fresh Sanitary Drinking Water is their main requirement. If you would expect them to produce for you these hot days, we would suggest that you investigate the

"Century" Sanitary Ice Cooled Drinking Fountain



E 4

The ICF 200 is specially adapted for small factories or can be furnished in larger sizes if desired. It can also be equipped with side or slant stream bubbler head. Cut E-4 illustrates but one of our many practical bubblers for sink or lavatory installation, etc.

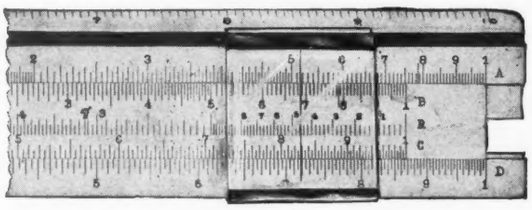
Our complete catalog and trade prices will interest you. WRITE TODAY.

Century Brass Works, Inc.
North Illinois St. Belleville, Ill.

An example:

$65^2 \div (51 \times 85)$

Try it on your rule



The center scale turns the trick

and on the PHILLIPS Slide Rule solves the above problem and many other problems with *one* slide movement instead of two or more movements as on other rules—it's a rule of speed, range and accuracy.

It pays to specify the name
DIETZGEN

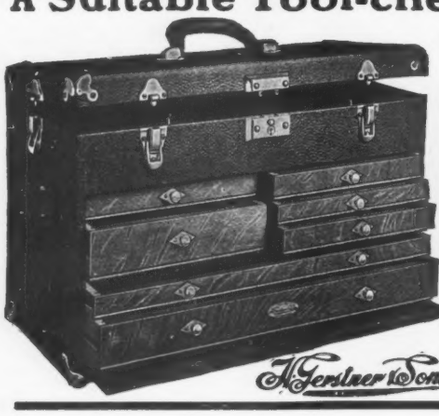
EUGENE DIETZGEN CO.

Right goods at right prices
continuously since Year 1885

Branches
Chicago New York
New Orleans Pittsburgh
San Francisco

Philadelphia Washington
Milwaukee
Factory
Chicago, Illinois

A Suitable Tool-chest for the MACHINIST *and* TOOLMAKER



One upon which you can depend for complete satisfaction, for long service, for perfection of design, workmanship and finish. Many sizes and styles shown in *free catalog.*

A. Gerstner & Sons. 208 Columbia St. Dayton, Ohio

Send for Catalogue AA

Wickes Continuous Electric Blue Printing Machine

Good prints, fast work, low costs on quantity production. Capacity rolls or sheets from 2" to 48" wide. Details.

1856-1924

WICKES BROS.

Builders of Heavy Duty Engine Lathes, Crankshaft Turning Equipment, Heavy Duty Plate and Structural Tools, Blue Printing Machines.

Saginaw, Mich., U. S. A.
501 Fifth Avenue, New York, N. Y.
736 White-Henry Bldg., Seattle, Wash.

UNIVERSAL DRAFTING MACHINES

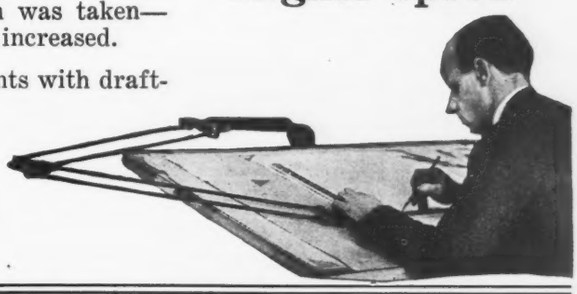
For efficiency in the drafting room—to enable each man to do his *best* work in the shortest time; to eliminate errors and erasures—install a Universal Drafting Machine at each table.

This big plant, manufacturing a machine known the world over for its efficiency and labor-saving qualities, had 35 Universal Drafting Machines in use when this photograph was taken—and are adding more as the size of their force is increased.

Let us tell you the names of some well-known plants with drafting rooms equipped for efficient production.

Write for details of Universal Drafting Machines.

Better Work at Higher Speed



UNIVERSAL DRAFTING MACHINE CO.
CLEVELAND, OHIO, U. S. A.

Good to the last fibre—

In sheets and rolls up to 62 in. wide.

When it comes to erasures, the draftsman can have unlimited confidence in

"DUPLEX"
Detail Drawing Paper

Its pure rag body gives it unusual strength and its texture allows of inking even over several erasures.

Buff color—Medium priced.

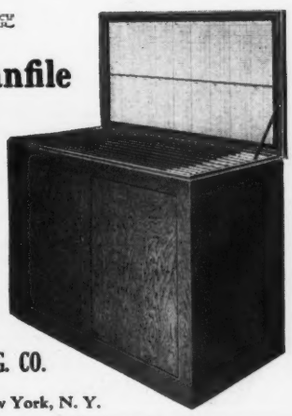
KEUFFEL & ESSER CO.
NEW YORK, 127 Fulton Street, General Office and Factories, HOBOKEN, N. J.
CHICAGO 315-319 S. Dearborn St. ST. LOUIS 817 Locust St. SAN FRANCISCO 20-24 Second St. MONTREAL 9 Notre Dame St. W.
Drawing Materials, Mathematical and Surveying Instruments, Measuring Tapes

REGISTERED
THE MARK OF QUALITY ECONOMY TO PROTECT THE USER
U. S. PAT. OFFICE

The Economy U-Planfile

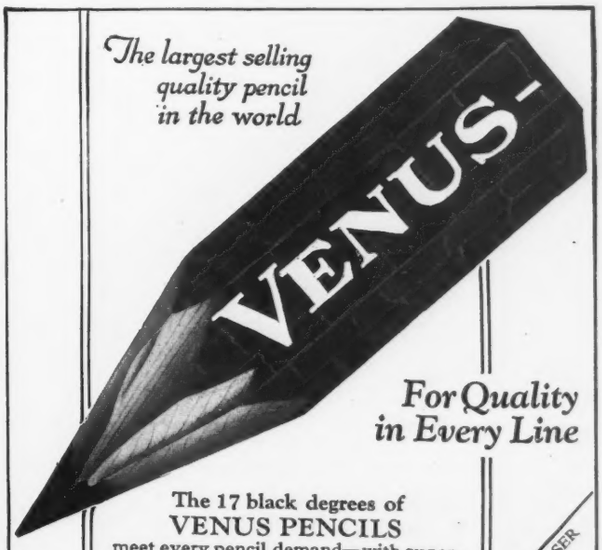
A vertical file constructed in wood. The special compression system in the pockets doubles the filing capacity. All drawings easily and quickly located. No jamming or crushing. One locking protects 4500 to 5000 drawings.

A complete line of horizontal blueprint files and drawing tables shown in catalog No. 18.



ECONOMY DRAWING TABLE & MFG. CO.
ADRIAN, MICHIGAN
Eastern Warerooms, 24 Horatio St., New York, N. Y.

The largest selling quality pencil in the world



For Quality in Every Line

The 17 black degrees of VENUS PENCILS
meet every pencil demand—with superlative smoothness. For drafting, sketching and writing, they are the world's accepted standard.

Plain Ends, per dozen . . . $1.00
Rubber Ends, per dozen . . 1.20

At Stationers and Stores throughout the world

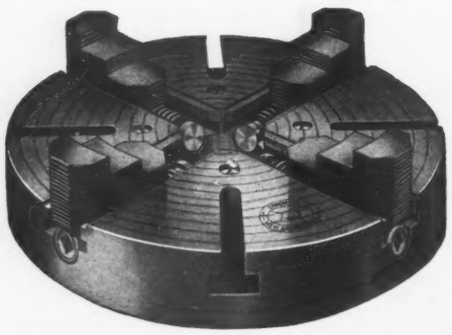
American Lead Pencil Co.
237 Fifth Avenue
New York

Venus Erasers made in 12 sizes

Mail coupon for free sample

Send Samples VENUS degrees checked—and a VENUS ERASER
For bold, heavy lines . . . 6B-5B-4B-3B
For general writing and sketching 2B-B-HB-F-H
For clean, fine lines . . . 2H-3H-4H-5H-6H
For delicate, thin lines . . . 7H-8H-9H

Name.....
Address.....
Profession.....



Your Best Insurance

in Heavy Duty Lathe Work is in using the Union All-Steel Independent Chuck. The body is made of a Steel Casting and is unbreakable.

Be sure to specify "Union" when buying chucks.

Made only by

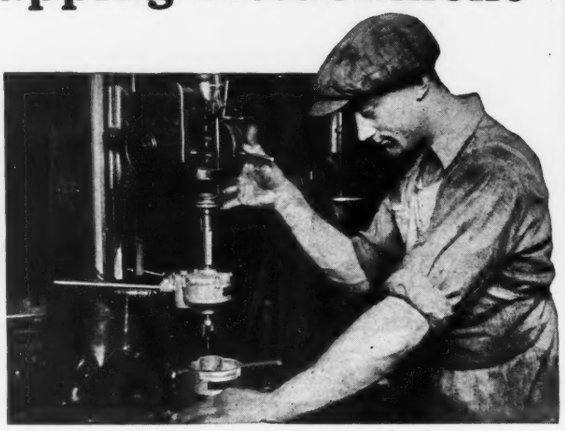
UNION MANUFACTURING CO., New Britain, Conn., U. S. A.

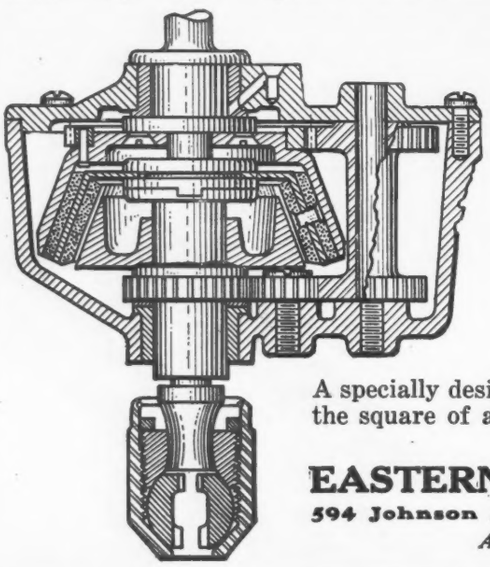
New York Office: 26 Cortlandt Street

Ettco High Speed Tapping Attachment

More Tapped Holes—Less Tap Breakage

A positive drive with safety slip *both* ways has put an end to the high cost of tapping. The secret is in the unique double-faced friction cone and duplicate sets of gears which distinguish the Ettco High Speed Tapping Attachment.





"Friction Going and Coming Saves Taps"

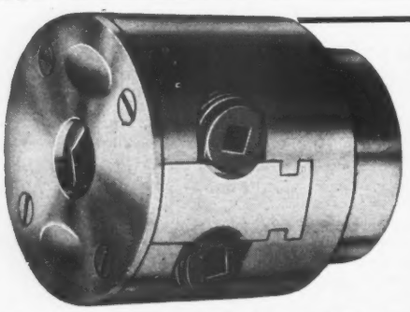
A simple device with few parts, provision for ample lubrication; attains high speeds without danger from hard spots or clogged chips, for the "slip" of the "Ettco" friction is as positively dependable as its driving and reversing mechanisms.

A specially designed chuck grips and centers on the round and drives on the square of all tap shanks up to ¼" diameter. Ask about free trial.

EASTERN TUBE & TOOL COMPANY, Inc.

594 Johnson Avenue BROOKLYN, N. Y.

Also Makers of Ettco Drill Chucks and Expanding Mandrels



CASLER Twin Screw Drill Chuck

Two screws in this Casler Chuck—the first is locked by the second, and both hold the drill in a firm grip. Three sizes, up to 1".

The best way to buy a tool is to find out its value first and pay for it afterward. We claim that Casler Tools will save time and trouble and improve your output—find out for yourself by trying them free for thirty days. Write for details.

PRODUCTION ENGINEERING CORPORATION

CANASTOTA, NEW YORK

Lavoie Air Chucks

See them in operation; note the small number of parts, the simplicity of operation. No objectionable cylinder at rear of spindle; only a single line of piping required.

The Frontier Chuck and Tool Co., Inc.

30 Letchworth St. BUFFALO, N. Y.

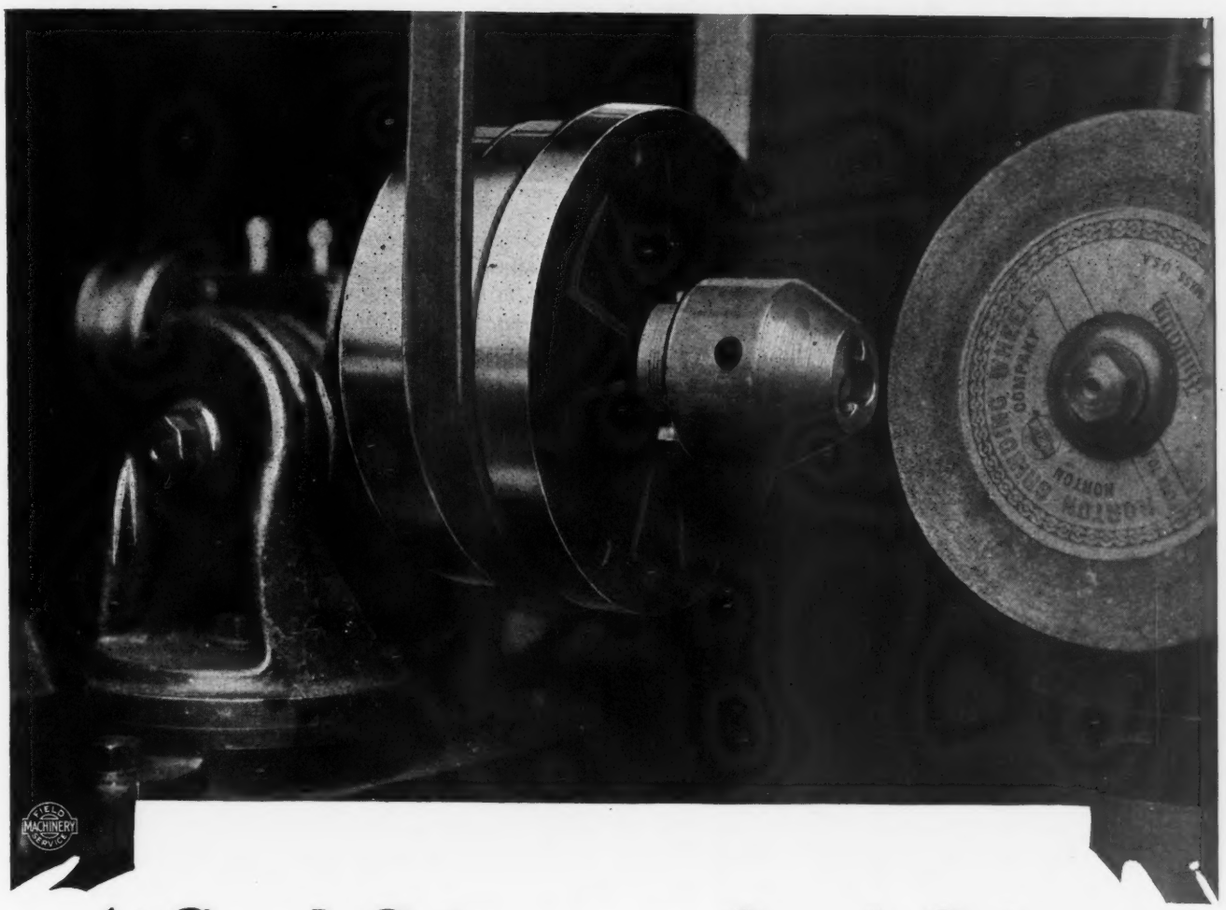
Facing on the Drill Press

Use the M-D Facing Head; it faces like a lathe, has a single point tool which travels radially from center outward or reverse; feeds automatically and faces diameters from 6" to 24".

Details and prices?

MUMMERT-DIXON COMPANY

HANOVER, PA.



A Good Grip *on a* Good Gripper

TWO chucks known to every mechanic—a shell for an Ettco Drill Chuck set upon a Walker Magnetic Chuck. This 6″ rotary type Walker Chuck serves many purposes in the Brooklyn shop of the Eastern Tube & Tool Co. It holds work of many kinds, for cylindrical and internal as well as for face grinding, with equal facility and dependability.

Convenience, gripping power and durability make Walker Magnetic Chucks invaluable wherever they are used; continuous improvements in design make them adaptable to practically every class of work.

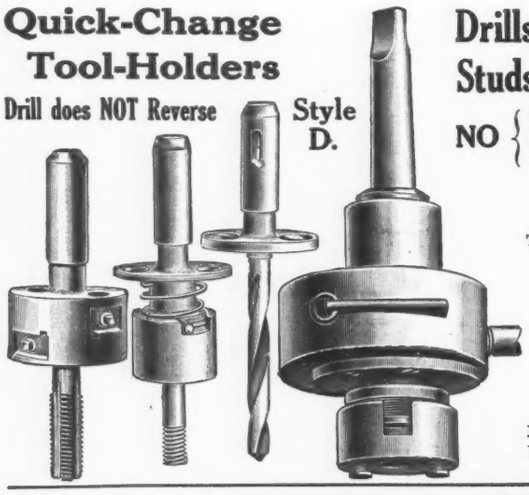
"The only way to hold some work, the best way to hold most of it." If you are not using a Walker Chuck or have not seen a recent model in use, ask us to refer you to a Walker enthusiast near your plant.

Send for our circular now.

O. S. WALKER CO., Inc., Worcester, Mass.

Quick-Change Tool-Holders

Drill does NOT Reverse — Style D.



Drills, Taps, Sets Studs in Line

NO { Stopping / Reversing / Moving Work / Changing Speed } *Phone Cortlandt 3149*

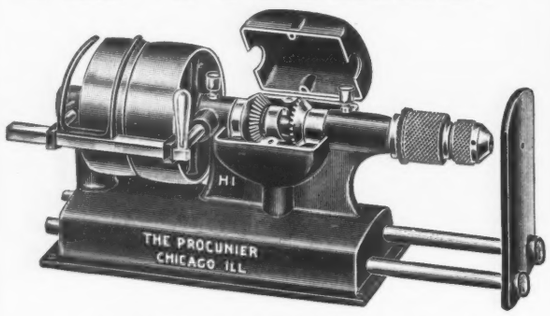
ERRINGTON

Main office: Broadway & John St., New York City
Boston Office: 830 Old South Building
Chicago Office: 612 W. Adams Street
Catalog Francais: Edgar Bloxham, Paris, 12 Rue du Delta

Auto Reverse TAPPING CHUCK

THIRTY YEARS ON THE MARKET HAVE TAUGHT ME
Simple Methods of Handling Work
AND HOW TO ADAPT MY
Positive, Friction and Interchangeable Tapping Devices
TO MEET
Every Condition of Tapping
MADE IN ALL SIZES FROM 1/16-IN. TO 2-IN. TAPS
Use Style D for work that is clamped down or work that is too heavy to center itself to the tap.

All "Procunier"

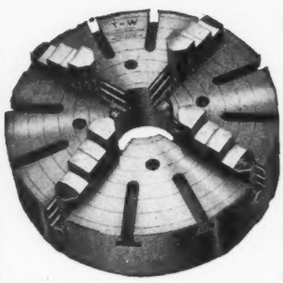


An Efficient Tapping Machine

This "Procunier" Bench Tapping Machine is equipped with the "Procunier" "Double-Jaw" Chuck; the "Procunier" Safety Tapping Device (patented) and the newly improved "Procunier" driving and reversible clutch mechanism. It sets high tapping standards for accuracy and production and practically eliminates tap breakage. If you do production tapping get a "Procunier" Machine.

Send for details of the "Procunier" line of safety tapping attachments, positive tapping attachments, safety tapping chucks, tap holders, and bench tapping machines.

WILLIAM L. PROCUNIER
18 So. Clinton Street, CHICAGO, ILL.



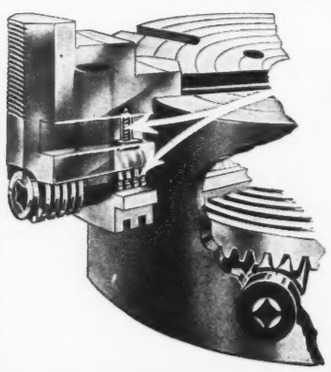
A STEEL Thrust Ring In Center of Chuck

takes all the strain of screws so that the chuck body *cannot* spring or break. This feature gives Terkelsen Independent Cast-iron-body Chucks the "*Strength of Steel.*" Ring is hardened and ground.

The Screws are threaded full length, having their thrust bearing near end, resulting in greater grip on jaws which are *double-grooved.*

Write for liberal Factory-Direct-to-You Offer

TERKELSEN MACHINE COMPANY
Manufacturers
TERKELSEN BLDG., 326 A ST., BOSTON, MASS.



The New Tri-Plex Chuck

Self-Centering
Independent
Eccentric

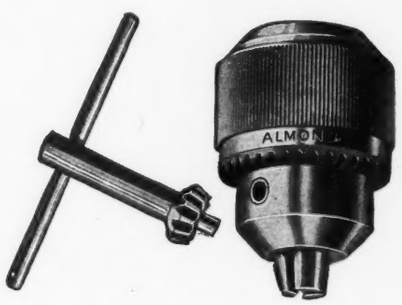
Described in Catalogue No. 42

THE CUSHMAN CHUCK CO. HARTFORD, CONN. U.S.A.

SINCE 1873

Almond

DRILL CHUCKS



T. R. ALMOND MFG. CO., Ashburnham, Mass., U. S. A.

JOHN UNIVERSAL CHUCKS—Did It!

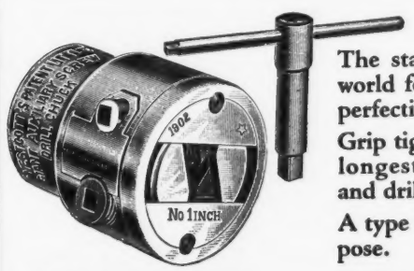
Drilling Production Doubled—Tripled—in some cases quadrupled!

Work—Better
Scrap—Less
Tool Life—Longer
Tool Breakage—Small

In One Drilling Department Number of Jobs Multiplied by more than Three!
Number of Operators Divided by more than Two!

BARBER-COLMAN CO
Rockford, Ill.

WESTCOTT CHUCKS



Little Giant Auxiliary Screw Drill Chuck

The standard of the world for mechanical perfection.

Grip tightest — wear longest. For lathes and drills.

A type for every purpose.

Write for catalog "M"

WESTCOTT CHUCK CO., Oneida, N.Y.

SWEETLAND CHUCKS

They Hold!

But holding isn't the only virtue a chuck needs to be a good investment. It must also be durable and versatile. Sweetland 4-Jaw Reversible Lathe Chucks meet all these requirements, and meet them well. Sizes 6" to 24" in 3" steps, to 42" in 6" steps. Send for catalog 13-C.

THE HOGGSON & PETTIS MFG. CO.
NEW HAVEN, CONNECTICUT, U. S. A.

BARKER* Wrenchless Chuck

A complete chucking unit in itself, requires no accessory installations.

It's the time wasted *between* operations that piles up costs on much turret lathe work.

The time *saved* in chucking and rechucking by the use of a Barker Wrenchless Chuck enables the Evinrude Motor Company, Milwaukee, Wisconsin, to machine more than 300 brass gear housing covers a day. The four operations take about a minute and a half to perform, setting up and changing the position of the work requires only a few seconds.

Barker Wrenchless Chucks are simple, instantaneous in action, self-centering and positive. They speed production in turret lathe work by cutting out every useless motion.

The "Barker Wrenchless Principle," a descriptive booklet that tells all about it—yours for the asking.

Thomas Elevator Company

(Chuck Division)

24 South Hoyne Ave., Chicago

*** The Barker Wrenchless Chuck was developed and is manufactured in the Chuck Division of Thomas Elevator Company—a separate department maintained for this single purpose.**

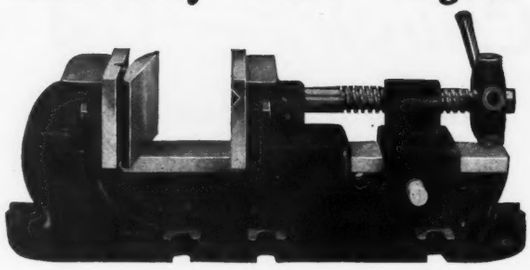
Boker Drill Chuck

Your Dealer Has It

A. V. Wiggins.....Syracuse, N. Y.
Wm. H. Taylor & Co., Inc.....Allentown, Pa.
Yerkes Tool Co.....Philadelphia, Pa.
Wheeling Machine Products Co., Wheeling, W. Va.
Heim's Machinists' Supply .....Rockford, Ill.
F. E. Satterlee Co.....Minneapolis, Minn.
Lake Shore Machinery Co.....Muskegon, Mich.
Berger & Carter Co.....San Francisco, Cal.
H. Boker & Co., Inc.....Boston, Mass.
H. Boker & Co., Inc.....Chicago, Ill.
H. Boker & Co., Inc.....Cleveland, O.
Pilot Steel & Tool Co.....Montreal, Canada

H. BOKER & CO., Inc.
103 Duane St., New York City, N. Y.

Holds Any Work—Tight!



The Gem Drill Press Vise has a quick-acting swivel jaw that holds work of any shape *rigidly* without the aid of special fixtures. Well built, powerful, durable—three sizes (largest opening to 10½") each one with a wide range that makes it useful in any shop.

Send for circular and prices.

J.E. MARTIN TOOL & DIE WORKS
548 West State St., Springfield, Ohio

The DANGER of not having enough
VISES

"Not enough" means that workers will often have to leave their working stations and go to some distant point to use a vise. Often they have to WAIT for a vise to be vacated, or make a second trip. Possibly they stop and talk to other workers on the way "out" and on the way "back"—two idle instead of one. Put a

REED VISE

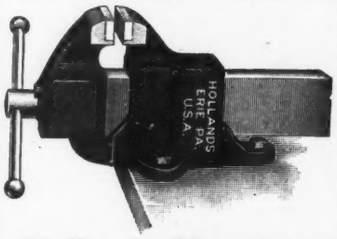
right at the work station of every worker who has even but occasional use for one and you will save money.

Reed Manufacturing Co., Erie, Pa.

Send for BOOKLET explaining the superiority of "Reed." Guaranteed throughout.

Hollands Vises

All Tools of Quality must bear prices in proportion to the time, skill, expense and investment attending their manufacture. Expensive Tools when justly estimated are the cheapest and the percentage of profit is less to the manufacturer, than the so-called cheap tools.



High grade tools cannot be made at small expense. This is especially true of Vises.

Hollands Manufacturing Company
ESTABLISHED 1887 ERIE, PA.

A Good Tap Drive
SAVES TIME AND TAPS

Your production analysis will show the advantages of the

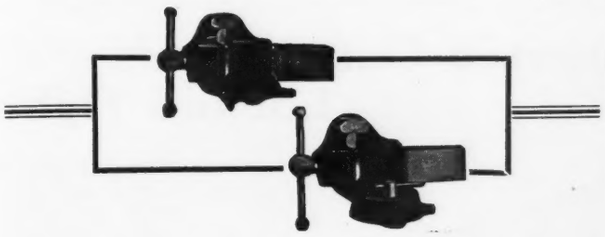
"Wear-Ever" Tap Chuck
and Driving Principle.

Made in one piece and hardened. Standard Tapers for all size taps in stock.

Write for details or trial chucks.

Taps are "Centered by the Shank" and "Driven by the Square"

SCULLY-JONES & CO.
TOOL DIVISION
13th and Robey Sts.,
CHICAGO, ILL.



Unbeatable!

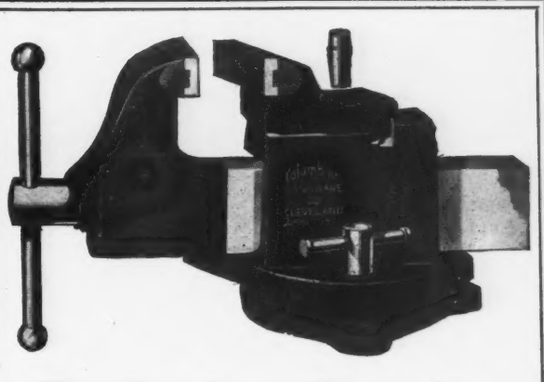
When it comes to long service Yost Vises are unbeatable. Made to meet high standards rather than to sell at a specific price; modern methods of manufacture and the large number produced have combined to keep the cost within the reach of every shop owner.

Skill, time and effort have been expended in the development of Yost Vises—they're remarkably good tools.

Let us send the Yost catalog.

YOST MANUFACTURING CO.
MEADVILLE, PA.

Yost Vises



Built for Service

Columbian Sledge-tested Vises have demonstrated, for many years, that there is no stronger or better made vise on the market.

These well-known vises are made of malleable iron in more than forty different sizes and in styles to suit the requirements of every shop.

The renewable jaw steel and swivel action of the model shown are two features that will appeal to every machinist.

Write for Complete Catalog

The Columbian Hardware Co.
Cleveland, Ohio

"LOGAN"
Air Operated Milling Machine Vise

Five Sizes

Send for the New "Logan" Catalog R-18

THE LOGANSPORT MACHINE CO.
Manufacturers of
"LOGAN" Air Operated Chucks and Labor Saving Devices
529 Market Street, LOGANSPORT, IND.

DRILL VISE

Three Sizes

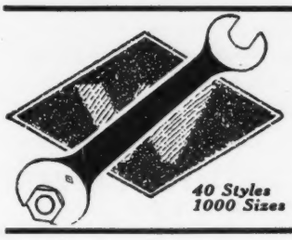
With and Without Jig Attachments. Often used on miller, shaper or planer.

Send for circulars.

Other Tools
Drill Speeders
Knurl Holders

The Graham Mfg. Co.
Providence, R. I.

France, Italy, Switzerland, Spain and Holland, Fenwick Freres & Co.



40 Styles
1000 Sizes

WILLIAMS
SUPERIOR DROP-FORGED TOOLS
WRENCHES

You and your workmen will like 'em. Ask for Wrench Book.

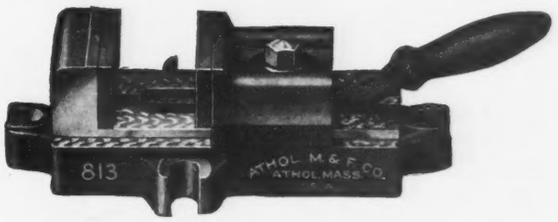
J. H. WILLIAMS & CO.
"The Wrench People"
New York Buffalo Chicago

Up Goes Your Profit

Do away with the elaborate drawings, patterns, castings or the machinery necessary for costly jigs and fixtures in your drilling and milling and what happens? Profit jumps so fast you wonder why somebody didn't put you "on" to

The Athol Drill Press and Milling Machine Vise

long ago; for that's what this vise does—jumps profit because it takes the place of jigs and fixtures for many pieces of work. Costs no more than an ordinary single purpose fixture. Attach special jaws and that's all that is necessary to convert it into a fixture for almost any job. ***You can't afford to be without it.***



Athol Machine & Foundry Co.
ATHOL, MASS., U. S. A.

Inserted Cutter Tools—Locked Tight

Metal Cutting Tools

The Lovejoy positive locking method makes a rigid, inserted tool that cannot break at the clamp; that combines the economy of the inserted cutter with the efficiency of the solid tool.

Send for a complete list of Lovejoy Money Saving Tools

The Lovejoy Tool Co., Inc.
Springfield, Vt.

Reduce the Cost of Nut Turning

by using the

FAVORITE
Reversible Ratchet
WRENCH

It avoids all the lost motion of the old-fashioned open end wrench.

Action is quick and straight ahead.

The "Favorite" wrench does not slip off the nut, but remains there until seated or removed.

Built strong for rough usage.

Greene, Tweed & Co.
Sole Manufacturers
109 Duane St. New York
Tool Department

Send for full particulars.

IF a press turns out one stamping a second—and if a broken spring means a delay of ten minutes, then it would have been less expensive in the first place to have specified

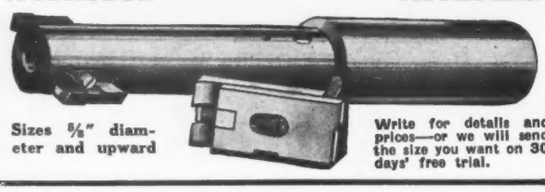
CHATILLON PRECISION SPRINGS
MEASURES FORCE AS YOUR WATCH MEASURES TIME

JOHN CHATILLON & SONS
Established 1835
85-99 Cliff Street, New York City, N. Y.

Holes Cost Less the Madison Way
COST FIGURES PROVE IT

It's cheaper to bore holes with Madison Adjustable Boring Cutters and Bars. Holes will be accurate to 0.00025". Especially valuable for odd sized holes. Does away with reamers.

MADISON MANUFACTURING COMPANY
MUSKEGON MICHIGAN



Sizes ⅝" diameter and upward

Write for details and prices—or we will send the size you want on 30 days' free trial.

REAL BARGAINS!

Just what you want in your shop—good tools at fair prices. Champion Tools encourage better work from the men who use them. "A tool well liked is a tool well used." Here are a few items from our line:

Champion Tool Holders
Champion Expanding Mandrels
Champion Shop Furniture
Champion Emery Wheel Dressers
Champion Lathe Dogs
Champion C. Clamps

Send for the Catalog

THE WESTERN TOOL & MFG. COMPANY
SPRINGFIELD, OHIO, U. S. A.

"COES"

Another Name for Wrench

When you buy wrenches don't experiment — specify Coes. Three models. Sizes from 6 inches to 6 feet. At good dealers everywhere.

COES WRENCH COMPANY

Established 1841

WORCESTER, MASS., U. S. A.

AGENTS

J. C. McCarty & Co., 29 Murray Street, New York City
J. H. Graham & Co., 113 Chambers Street, New York City

The Gammons Taper Pin Reamer

Saves 65% of Reaming Costs

It reams in any metal at least three times as fast as fluted reamers and the average breakage is one-tenth that of the best fluted reamers made.

For use in a drill press, electric or air drill. May be run at any reasonable feed or speed without fear of breakage.

Why not save the two-thirds in costs? Only too glad to explain fully

The Gammons-Holman Co.

Dept. M. Manchester, Conn.

This Angle Plate Solves Many Problems

The Boston Universal Angle Plate is adjustable to any angle. Simply clamp the work and adjust to the desired angle. Vernier attachment is accurate to 5 minutes. Cut shows the Boston Angle Plate and work on a surface plate for gaging.

Four sizes, two styles. Details on request.

Boston Scale & Machine Company

100 Ruggles St., Boston, Mass.

Agents for Great Britain, Belgium, Italy, India, Burmah and Ceylon, Japan, Formosa and Korea. Alfred Herbert, Ltd., Coventry, England.

American Swiss Files

The Trade Mark Confirms what the Old Timer "Feels"

The Old-Timer claims he can tell a good file by the "feel"; but why depend on his judgment? The sure way is to standardize "*American Swiss*" for your fine filing. The "Stars and Cross" trade mark can't be mistaken. American Swiss Files are guaranteed to be uniformly correct in design and cut and scientifically heat-treated.

Our new booklet describes and illustrates the full line of American Swiss Files—send for your copy.

American Swiss File & Tool Company

410-416 Trumbull St. ELIZABETH, N. J.

DISTRIBUTORS

Baltimore, Md., The L. A. Benson Co.; Boston, Mass., Chandler & Farquhar Co.; Bridgeport, Conn., Hunter & Havens; Buffalo, N. Y., Louis F. Seltenreich; Chicago, Ill., Machinists Supply Co.; Cincinnati, O., E. K. Morris & Co.; Cleveland, O., White Tool & Supply Co.; Dayton, O., M. D. Larkin Co.; Detroit, Mich., Boyer Campbell Co., Chas. A. Strelinger Co.; Elizabeth, N. J., Frank Hand Co.; Hartford, Conn., Tracy, Robinson & Williams Co.; Indianapolis, Ind., Vonnegut Hardware Co.; Long Island City, N. Y., Long Island Hardware Co.; Los Angeles, Cal., Ducommun Hardware Co.; Newark, N. J., Ludlow & Squier; New Haven, Conn., C. S. Mersick & Co.; New York City, N. Y., Anchor Tool & Supply Co.; Passaic N. J., New Jersey Engineering & Supply Co.; Philadelphia, Pa., Aetna Machinery Co.; Pittsburgh, Pa., Machinists Supply Co.; Providence, R. I., Belcher & Loomis Hardware Co.; Rochester, N. Y., Sidney B. Roby Co.; Rockford, Ill., Swords Brothers Co.; San Francisco, Cal., C. W. Marwedel; Springfield, Mass., W. J. Foss Co.; St. Louis, Mo., St. Louis Machinists Supply Co.; Syracuse, N. Y., Syracuse Supply Co.; Toledo, O., Coghlin Kirkby Machinery & Supply Co.; Toronto, Ontario, Canada, The Masco Co., Ltd.; Waterbury, Conn., The Hamilton Hardware Corp.; Worcester, Mass., Duncan & Goodell Co.

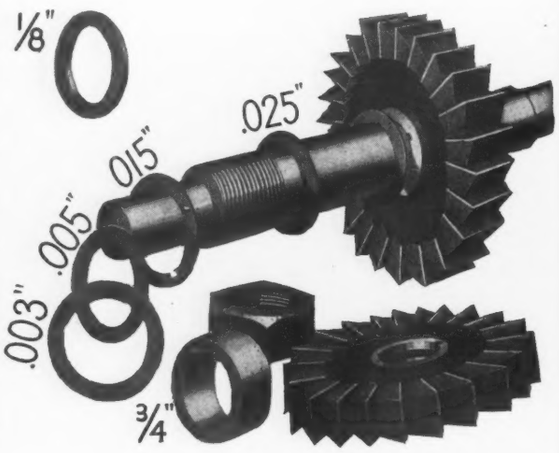
Count the minutes, if you would save the hours!

Figure it out yourself: One piece of scrap, ten minutes or more wasted finding the right thickness, another ten to thirty minutes with shears and punch press, and then a crudely-made spacing washer that may or may not fit. If it doesn't, try again. How much better a complete assortment of

Detroit Spacing Washers

in 19 Arbor sizes and 18 thicknesses! The right size and the right thickness immediately at hand. Hours saved in a month—many days in the course of a year. Made of good open hearth cold rolled steel.

Send for samples and prices. The low cost will convince you.



Stock sizes for arbors of the following diameters:

⅜, ½, ⅝, ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1⅝, 1¾, 1⅞, 2, 2¼, 2½, 3, 3½ and 4 inches and larger.

Stock Thicknesses: .001, .002, .003, .004, .005, .006, .007, .008, .010, .012, .015, .020, .025, .032, .047, .063, .093 and .125 inch.

Spacers thicker than ⅛" are turned from tubing but not carried in stock.

Detroit Stamping Co.
3445-3459 West Fort Street
DETROIT, MICHIGAN, U. S. A.

GITS OIL CUPS

Write for catalog No. 20 showing 255 full size illustrations with detail dimensions of STANDARD and some SPECIAL OIL CUPS

Style "WC"

Gits Gravity and Wire Wick Feed Oilers

Gravity Feed—flushes the bearing.
Wire Wick Feed—gives desired prolonged feed.
Wire Cored Wick—replaces waste or felt

Made in standard sizes

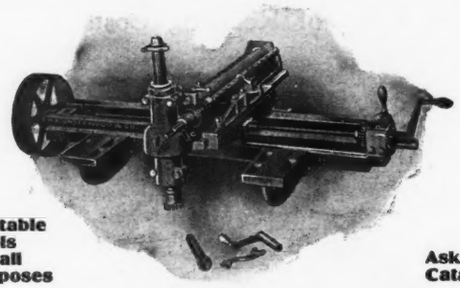
The Hinge

Style D Style U Style L Style B Style G Style A

Oil cups for every lubricating need. State style and size in which you are interested, and we will send free sample and catalog

Gits Bros. Manufacturing Company
1911 S. Kilbourne Avenue CHICAGO, ILLINOIS

UNDERWOOD PORTABLE TOOLS



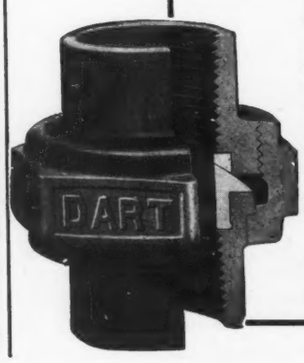
Portable Tools for all Purposes

Ask for Catalog

H. B. UNDERWOOD CORPORATION
1025 Hamilton Street Philadelphia, Pa.

DART UNIONS

Save the Pipe



Ells, Tees and Flanges that will not leak; with bronze to bronze seats that cannot rust or corrode.

Send for price list and sample.

E. M. Dart Mfg. Co.
Providence, R. I.
The Fairbanks Co., Sales Agents
Canadian Factory:
Dart Union Co., Ltd., Toronto

GREASE CUPS!

Empress Grease Cup No. 249

Empress Oil Cup No. 52

Empress Cups Insure Perfect Lubrication for Your Machines

They keep the dirt out let the lubricant in; small but important accessories, they solve the lubrication problem for the machine designer. Specify Empress lubricators.

The large cut shows the Empress Grease Cup No. 249; the small one Empress Oil Cup No. 52—two of our most popular cups. Advise the one you want (both if you're interested) and we'll send samples.

REG. U. S. PAT. OFF. Empress

Mail the Coupon To-Day

BOWEN PRODUCTS CORP., Auburn, N. Y.

Clip this coupon and attach to your letterhead.
Please send me sample of your Empress Grease Cup No. 249. ☐ Empress Oil Cup No. 52 ☐ and Catalog No. 101 J of your entire line.

NAME ..... TITLE .....

FIRM .....

ADDRESS .....

M-8-24

PUMPS

A type for every service.

Bulletins on request.

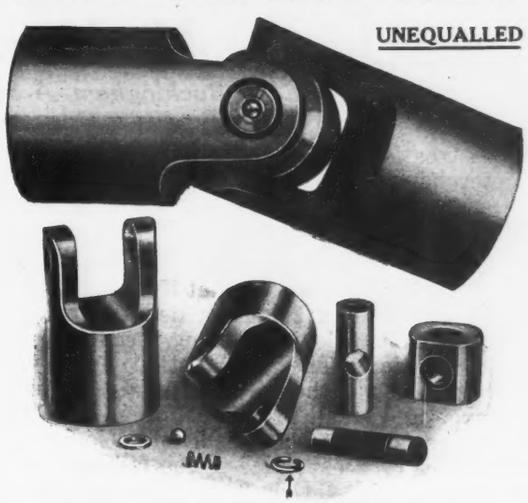
THE GOULDS MANUFACTURING CO.
SENECA FALLS, N. Y.

Branches or agencies in all principal cities.

GOULDS

Curtis Universal Joints

UNEQUALLED



This joint is made of high grade alloy steel with all bearing surfaces hardened.

It contains no lock screws, nuts or rivets.

Actual tests have proven the superiority of the CURTIS JOINT.

Made in all sizes from 3/8 to 4" diameter inclusive.

Send for special circular.

Sole Distributors for U. S. A.

BOSTON GEAR WORKS

NORFOLK DOWNS, QUINCY, MASS.

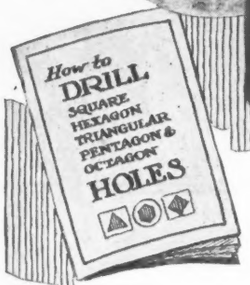
Branches at

BOSTON NEW YORK CLEVELAND CHICAGO

Drill Them—

Hexagon
Triangular
Square
Pentagon
Octagon

Send for the "How To" book



These are drilled holes—accurate in size—true to form—with good finish.

You may find it hard to believe that holes other than round can be drilled on an ordinary drill press, with inexpensive tools, and at speeds almost as fast as you can drill round holes. It is our business to prove these statements. Write for the facts.

WATTS BROS. TOOL WORKS
TURTLE CREEK PA., U. S. A.

Of What Does This Remind You?

SUPPOSE that you had on hand when your first tap was broken, a commercial device built especially to remove the broken pieces of tap, a commercial device, not a home-made article, would you not have saved a great deal of time?

Write Us for Information

The Walton Company
310 PEARL STREET HARTFORD, CONN.

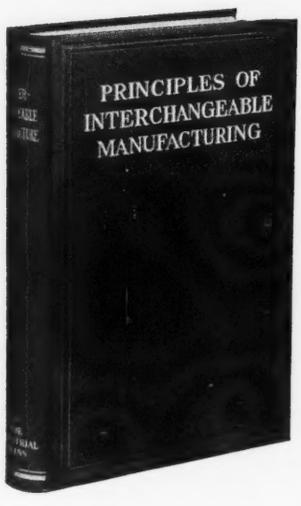
Principles of Interchangeable Manufacturing

By Major Earle Buckingham, A.S.M.E., S.A.E.
Engineer, Pratt & Whitney Co.

A treatise on the Basic Principles involved in Successful Interchangeable Manufacturing Practice covering Design, Tolerances, Drawings, Manufacturing Equipment, Gaging and Inspection.

This is the first complete treatise on interchangeable manufacturing, as a whole, that has appeared and *it was written by an authority.* The book defines and emphasizes the underlying basic principles, using specific methods to illustrate their application. The information upon which this treatise is based was gathered from many manufacturing plants both large and small in this country and Canada. Every method discussed is in successful operation and for that reason the book is of great value to the industry.

In this book, as well as in every volume of MACHINERY'S Books on Machine Shop and Drafting-Room Practice, you will find a Self-Examination Sheet which enables the reader to get the utmost possible value out of the book. The Self-Examination Sheet makes home study easy and interesting.



254 Pages—6 x 9 inches—Fully Illustrated

FREE INSPECTION COUPON

THE INDUSTRIAL PRESS,
140-148 Lafayette Street, New York City.

You may send me, all delivery charges paid, for five days' examination, your book "Principles of Interchangeable Manufacturing." I will either return it in five days or send you $3.00 within 30 days, paying for it in full.

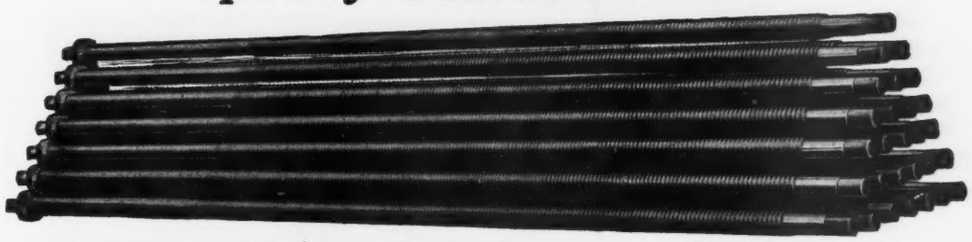
Name .....

Address .....City and State .....

Position .....Firm .....

8-24

For Screws in that New Machine Specify HINDLEY



LET Hindley Screws take care of power, lead and feed requirements—and you will stop worrying about screws.

Hindley Screws are cut on specially designed machines that remove metal with least possible disturbance to fibre.

Let us quote prices on your next job—prices that are as convincing as the quality of our screws!

HINDLEY GEAR COMPANY, 1105 Frankford Ave. Philadelphia, Pa.

THE SOCIETE GENEVOISE

Has Just Doubled its Facilities for Making its Line of

Locating and Jig-Boring Machines

MADE IN FOUR SIZES

No. 1—For Watchmaking—Ask for Catalog No. 289.
No. 2—For Clockmaking, Sewing Machines, Typewriters and Similar Products—Ask for Catalog No. 304.

No. 4—Capacity 16x24x20" } For larger Jigs, Fixtures, Dies, Gages and Templets—ask for Catalog No. 392.
No. 5—Capacity 24x32x26" }

These machines save 40 to 80% of the usual time required to produce accurate holes in jigs and fixtures.

Let us tell you about them.

THE R. Y. FERNER CO.
INVESTMENT BUILDING WASHINGTON, D. C.

FEDERAL Dial Indicators

The four things you want in gaging equipment—Accuracy, Durability, Readibility and Quick Repair Service—you get in Federal Dial Indicators. When the dial points to minus .0005" you can read it instantly, and you know it's *right!* Federal Dial Indicators absorb many hard knocks without requiring adjustment. Send for the complete catalog and price list.

If our Repair Department can't adjust your Federal within 12 hours, a new instrument will be returned to you within that time, and the charge will be only for repairing the old.

FEDERAL PRODUCTS CORPORATION
PROVIDENCE, R. I.

SALCO TRADE MASTER BRAND STEEL STAMPS

They Stand the "Gaff"

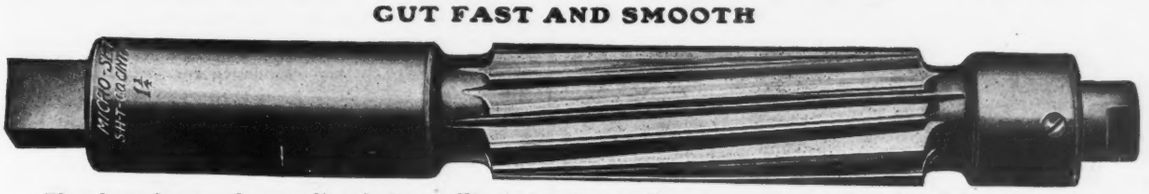
Made from Specially Selected Steels, Scientifically Heat-treated and Tested.

Cutting mechanically correct—guaranteed by the manufacturers.

Schoder & Lombard Stamp Co.
202 Centre St., New York, N. Y.

The "Micro-Set" Expansion Spiral Hand Reamers

CUT FAST AND SMOOTH



They have improved expanding features. The body of expanding screw fits closely into pilot and always maintains alignment. They are true after expanding. Micrometer dial on end of pilot gives readings in ¼ thousandths. Large range of expansion. They will ream true holes in keyseated or oil-grooved holes. Made in spiral or straight flutes and special lengths. All sizes can be shipped from stock.

THE SCHELLENBACH-HUNT TOOL CO., 116-124 Opera Place, Cincinnati, O.

F. E. Tighe Sales Company
2953 Montgomery Avenue, Detroit, Mich.

H. E. Barton Tool Company
104-106 South Jefferson St., Chicago, Ill.

Call for Radio Taps

The call for taps that will stand up and give good production in materials used in radio construction, bakelite, fibre, hard rubber, soft forgings, brass, copper, cast aluminum and like material, is as insistent as the SOS call of distress.

The answer to the call is Card High Speed Hand and Machine Screw Taps, two and three flute types for bakelite, fibre and hard rubber. They are specially tempered to withstand the wear caused by the gritty nature of these materials, which soon wears the average tap below size. For soft forgings, brass, copper and cast aluminum use carbon steel taps; two and three flutes for blind holes and spiral fluted for through holes.

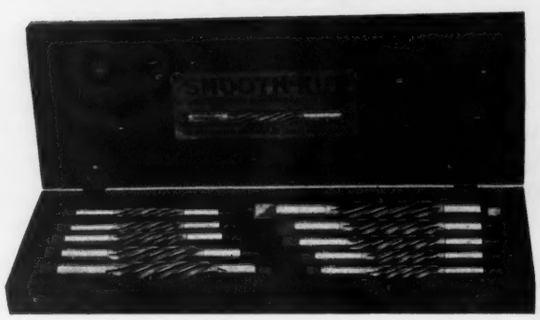
Don't wait for mounting tapping costs to convince you—send for a trial order of Card Taps *now*.

The CARD Quality

S. W. Card Manufacturing Co.
Division of Union Twist Drill Co.
MANSFIELD MASS., U. S. A.
New York Office: 63 Reade St.

EUROPEAN AGENTS: Chas. Churchill & Co., London, Birmingham, Manchester, Glasgow and Newcastle-on-Tyne. Markt & Company, Ltd., 107 Avenue Parmentier, Paris, France. Charles L. Demoor, 169 Rue du Progres, Brussels, Belgium. V. Lowener, Vesterbrogade 9 B, Copenhagen, Denmark. V. Lowener, Drottingattan 90, Stockholm, Sweden. V. Lowener's Maskinforettning, Sverre Mohn, Christiania, Norway. R. S. Stokvis & Zonen, Ltd., Rotterdam. C. Civita, Milan, Italy. Hijo de Miguel Mateu, of Barcelona, and Bilbao, Spain. A. M. Papasideris & Co., Athens, Greece. Mestre & Blatge, Rio de Janeiro, Brazil; Buenos Aires, Argentine Republic.

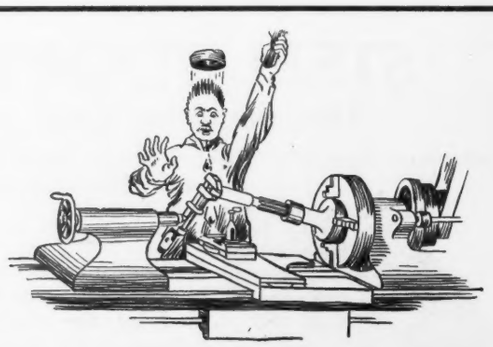
SMOOTH-KUT Expansion Piston Pin Reamers in Sets



The sets cover all piston pin sizes and are invaluable for use in machine shops, garages and repair shops.

The SMOOTH-KUT has no equal for piston pin work. It is the only helical flute expansion reamer ever produced and is the reamer you have been looking for for years.

Millersburg Reamer & Tool Co.
Incorporated
Millersburg, Pa., U. S. A.

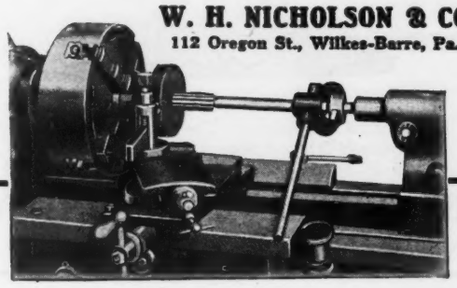


If you ever ran a lathe it has surely happened to you. It continues to happen daily in almost all shops.

Until the Nicholson Reamer Holder was invented there was no other method by which a mechanic could keep his reamer from jumping in, or prevent it from reaming a tapered hole. This Holder can also be used instead of a chuck for drills and as a hold back in a lathe. It has many uses and saves double its cost in a short time. No. 1 size takes straight shank reamers and drills up to 1" dia., and No. 2 takes up to 2" in dia.

Send us sketch of socket or number of Morse taper of lathe you would like to try one on, and we will send it on trial. If you desire further information and circular, write us.

W. H. NICHOLSON & CO.
112 Oregon St., Wilkes-Barre, Pa.



The Green Section

Used and Rebuilt Metal-working Machines, Tools and Accessories

INDEX OF DEALERS AND MANUFACTURERS OFFERING USED MACHINES

Arranged so the buyer can see at a glance what selection, in the machines that interest him, is offered in the advertising pages following.

AIR COMPRESSORS
Osborne & Sexton Mchy. Co., Columbus, O.

BENDING ROLLS
Osborne & Sexton Mchy. Co., Columbus, O.

BOLT CUTTERS
Eastern Machinery Co., Cincinnati.
D. C. Oviatt & Co., Cleveland.
Henry Prentiss & Co., Inc., New York City.

BORING MILLS
Eastern Machinery Co., Cincinnati.
E. A. Kinsey Co., Cincinnati.
Lynd-Farquhar Co., Boston.
Miles Machinery Co., Saginaw, Mich.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.

BRAKES
Osborne & Sexton Mchy. Co., Columbus, O.
D. C. Oviatt & Co., Cleveland.

BROACHING MACHINES
Henry Prentiss & Co., Inc., New York City.

BULLDOZERS
Eastern Machinery Co., Cincinnati.
D. C. Oviatt & Co., Cleveland.
Reliance Machinery Sales Co., Pittsburgh.

CRANES
Henry Prentiss & Co., Inc., New York City.

DIE SINKER
Lynd-Farquhar Co., Boston.

DRILLING MACHINES
H. F. Allen Co., Inc., New York City.
Eastern Machinery Co., Cincinnati.
Harvard Electric Co., Chicago.
Hill, Clarke & Co., Inc., Boston.
E. A. Kinsey Co., Cincinnati.
Mueller Machine Tool Co., Cincinnati.
Osborne & Sexton Mchy. Co., Columbus, O.
D. C. Oviatt & Co., Cleveland.
Henry Prentiss & Co., Inc., New York City.
Reliance Machinery Sales Co., Pittsburgh.

FORGING MACHINES
D. C. Oviatt & Co., Cleveland.

GEAR CUTTING MACHINES
Eastern Machinery Co., Cincinnati.
Hill, Clarke & Co., Inc., Boston.
E. A. Kinsey Co., Cincinnati.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.

GRINDING MACHINES
H. F. Allen Co., Inc., New York City.
Eastern Machinery Co., Cincinnati.
Harvard Electric Co., Chicago.
Hill, Clarke & Co., Inc., Boston.
E. A. Kinsey Co., Cincinnati.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.

HARDNESS TESTING APPARATUS
Osborne & Sexton Mchy. Co., Columbus, O.

HEAT-TREATING FURNACE
Chambers, Bering, Quinlan Co., Decatur, Ill.

HAMMERS
H. F. Allen Co., Inc., New York City.
Eastern Machinery Co., Cincinnati.
Lynd-Farquhar Co., Boston.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.
Reliance Machinery Sales Co., Pittsburgh.

KEYSEATERS
Henry Prentiss & Co., Inc., New York City.

LATHES
H. F. Allen Co., Inc., New York City.
Eastern Machinery Co., Cincinnati.
E. L. Essley Machinery Co., Chicago.
Hill, Clarke & Co., Inc., Boston.
E. A. Kinsey Co., Cincinnati.
Miles Machinery Co., Saginaw, Mich.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.
Reliance Machinery Sales Co., Pittsburgh.

MILLING MACHINES
H. F. Allen Co., Inc., New York City.
Eastern Machinery Co., Cincinnati.
Harvard Electric Co., Chicago.
Hill, Clarke & Co., Inc., Boston.
Jones Machine Tool Co., Cincinnati.
E. A. Kinsey Co., Cincinnati.
Miles Machinery Co., Saginaw, Mich.
Osborne & Sexton Mchy. Co., Columbus, O.
D. C. Oviatt & Co., Cleveland.
Henry Prentiss & Co., Inc., New York City.
Reliance Machinery Sales Co., Pittsburgh.

MOTORS
Osborne & Sexton Mchy. Co., Columbus, O.

PIPE MACHINES
Osborne & Sexton Mchy. Co., Columbus, O.
Reliance Machinery Sales Co., Pittsburgh.

PLANERS
H. F. Allen Co., Inc., New York City.
Eastern Machinery Co., Cincinnati.
E. A. Kinsey Co., Cincinnati.
Lynd-Farquhar Co., Boston.
Miles Machinery Co., Saginaw.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.
Reliance Machinery Sales Co., Pittsburgh.

PRESSES
Jones Machine Tool Co., Cincinnati.
Lynd-Farquhar Co., Boston.
D. C. Oviatt & Co., Cleveland.
Reliance Machinery Sales Co., Pittsburgh.

PROFILERS
Lynd-Farquhar Co., Boston.

PUNCHES AND SHEARS
Jones Machine Tool Co., Cincinnati.
Lynd-Farquhar Co., Boston.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.
Reliance Machinery Sales Co., Pittsburgh.

RIFLING MACHINES
Henry Prentiss & Co., Inc., New York City.

RIVETING MACHINES
E. A. Kinsey Co., Cincinnati.
Osborne & Sexton Mchy. Co., Columbus, O.

ROLLING MILLS
Henry Prentiss & Co., Inc., New York City.

SAWING MACHINES
Osborne & Sexton Mchy. Co., Columbus, O.
Reliance Machinery Sales Co., Pittsburgh.

SCREW MACHINES, AUTOMATIC
Cincinnati Automatic Mach. Co., Cincinnati.
E. A. Kinsey Co., Cincinnati.
J. L. Lucas & Son, Inc., Bridgeport, Conn.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.

SCREW MACHINES, HAND
(See Turret Lathes)

SHAFT STRAIGHTENER
Lynd-Farquhar Co., Boston.

SHAPERS
H. F. Allen Co., Inc., New York City.
Eastern Machinery Co., Cincinnati.
Harvard Electric Co., Chicago.
Hill, Clarke & Co., Inc., Boston.
Miles Machinery Co., Saginaw, Mich.
Osborne & Sexton Mchy. Co., Columbus, O.
Henry Prentiss & Co., Inc., New York City.

SLOTTERS
Reliance Machinery Sales Co., Pittsburgh.

TAPPING MACHINES
D. C. Oviatt & Co., Cleveland.

TURRET LATHES AND HAND SCREW MACHINES
H. F. Allen Co., Inc., New York.
Eastern Machinery Co., Cincinnati.
Harvard Electric Co., Chicago.
Lynd-Farquhar Co., Boston.
Miles Machinery Co., Saginaw, Mich.
Osborne & Sexton Mchy. Co., Columbus, O.
D. C. Oviatt & Co., Cleveland.
Henry Prentiss & Co., Inc., New York City.

If the machine tools you want are not listed in the following pages write the Green Section—we will be glad to help locate them without charge

SECOND HAND MACHINE TOOLS

DRILLS

No. ½ Avey ball bearing bench.
1-spindle Allen ball bearing.
4-spindle Avey ball bearing.
20", 24", 26", 28", 32" uprights, all makes.
3, 4, 5, 6 ft. radials, all makes.
4' Hammond high speed wall radial.
D-2 Colburn manufacturing drill.
No. 513 Baker, heavy manufacturing type.
No. 12 Natco multiple spindle drill.
No. 14 Natco multiple spindle drill.
8 spdl. Fox multiple spindle drill.
2, 3 and 4 spindle Barnes 20" humpback all geared drills.

BORING MILLS

No. 41 Rochester floor type horizontal motor drive.
No. 0 Giddings & Lewis, table type, horizontal 3" bar.
No. 2 Rockford horizontal boring and drilling machine.
Bement-Niles R. & L. table type, horizontal, 3⅞" bar.
24" and 42" Bullard, New Era Type.
34" Colburn, vertical type, turret head.
48" Colburn, 1 regular head, 1 turret head.
54" Bullard, rapid production.
62" Rogers, 2 heads on rail.
100" J. M. Poole, 2 heads on rail.

GRINDERS

No. 1 Brown & Sharpe universal.
12" x 36" Cincinnati Universal.
3", 6" and 10" swing x 18", 32", 36", 50" and 72" long Norton plain.
No. 10 Brown & Sharpe, plain.
No. 16 Blanchard rotary surface, motor driven.
10" Garrigus rotary surface.
No. 1 and 1½ Cincinnati complete cutter and tool.
No. 3 Brown & Sharpe cutter and tool.
No. 2 Walker cutter and tool.
No. 13 Brown & Sharpe cutter and tool.
No. 2 Oakley cutter and tool.
Nos. 1 and 2 Norton cutter and tool.
No. 60 Heald cylinder.
No. 70 Heald internal.
Taylor high speed water tool.
30" Besly disc.
No. 12—26 Besly double wheel disc grinder.

SCREW MACHINES AND TURRET LATHES

No. 0 Brown & Sharpe automatic.
⅝", 5/8", ⅞" Cleveland automatic, model "B."
½" and 1¼" Cleveland automatic, model "A."
1¾" Gridley multiple spindle automatic.
4¼" Gridley single spindle automatic, motor drive.
⅞" and 1" Brown & Sharpe and Warner & Swasey wire feed.
1½"-2¼" Cincinnati-Acme, wire feed.
1½" Pratt & Whitney, wire feed.
2¼" and 3¼" Cincinnati-Acme flat turret, bar and chucking.
2" and 3" Jones & Lamson flat turret type, bar and chucking equipment.
16" and 18" Acme and Warner & Swasey Fox turret lathe, with chucking bars.
2 spdl. Jones & Lamson flat turret lathe, chucking equipment.
No. 4 Warner & Swasey Universal Turret Lathe.
22" Libby turret lathe.
21" Gisholt Turret Lathe.

LATHES

Adams short cut manufacturing lathe.
Porter Cable manufacturing lathe.
16" x 6' LeBlond high duty manufacturing lathe.
16" x 8' Lodge & Shipley manufacturing lathe.
16" x 8' Automatic Machine Co., threading lathe
16" x 8' Hendey cone head lathe.
16—18" x 6' Lodge & Shipley, P.C.F., C.R.
16" x 8' Lodge & Shipley, C.R., P.C.F., geared head.
16" x 8' LeBlond, C.R., P.C.F., cone head.
18" x 16' LeBlond, C.R., P.C.F., cone head.
18" x 8' Lodge & Shipley, C.R., P.C.F., cone head.
18" x 8' Lodge & Shipley, C.R., P.C.F., geared head.
18—20"x9' Lehman, C.R., P.C.F., geared head.
22" x 10' American, C.R., P.C.F., geared head.
20—22" x 10' Lodge & Shipley, C.R., P.C.F., geared head.
24—27" x 10' Lodge & Shipley, C.R., P.C.F., geared head.
24" x 22' Lodge & Shipley, C.R., P.C.F., cone head.
20" x 8' American, C.R., P.C.F., cone head.
24—46" x 10' Fay & Scott gap lathe, C.R., P.C.F., cone head.
18—36" x 8' Fay & Scott gap lathe, C.R., P.C.F., cone head.
3½" x 60" Lo-swing lathe.

SHAPERS AND PLANERS

6" Pratt & Whitney vertical.
12" Smith & Mills, crank.
16" and 20" Gould & Eberhardt, back geared crank.
16" Flather revolving knee, crank.
18" Stockbridge, back geared, crank.
24" Cincinnati, back geared, crank.
18" x 48" Niles traveling head, 2 tables.
15" and 20" Hendey friction driven.
26" x 7' Gray planer, 1 head, belt drive.
30" x 6' Gray planer, 2 heads.
36" x 10' Gray planer, 2 heads, motor drive.
36" x 12' Cincinnati planer, 4 heads, belt drive.
54" x 16' Powell planer, 4 heads, belt drive.
66" x 12' Pond planer, 2 heads, belt drive.
72" x 20' Gleason planer, 3 heads, belt drive.

MILLERS

No. 1½ and 2 Cincinnati universal.
No. 2 Hendey universal.
No. 4-A Brown & Sharpe universal high power.
No. 2 Cincinnati plain, cone drive.
No. 3 Cincinnati plain, high power.
No. 3 Kearney & Trecker plain, high power.
No. 4 Cincinnati plain, high power.
Nos. 3 and 4 Cincinnati vertical, high power.
C-2 Becker vertical, high power.
4½" x 12" Pratt & Whitney, thread type.
No. 0 Van Norman duplex.
No. 2 Warner & Swasey manufacturing.
Pratt & Whitney double spline.
28" Cincinnati, semi-automatic.

MISCELLANEOUS

No. 1-2-3 Lapointe broaching machines.
Brown & Sharpe lead lapp.
1-ton portable crane.
10 assorted sizes power presses (all makes).
No. 2 Catlin keyseater.
½" Landis bolt cutter.
52" foot power Niagara squaring shear.
100 lb. Bradley compact power hammer.
Pratt & Whitney pistol rifling machine.
No. 3 Barber-Colman automatic hobbing mch.
18" Gould & Eberhardt hobbing machine.
36" Gould & Eberhardt automatic gear cutter, spur and bevel.
200 ton Burroughs hydraulic press and pump.
8" x 12" H. J. Ruesch rolling mill, motor drive.

HENRY PRENTISS & COMPANY, Inc., 149 Broadway, New York
BOSTON SYRACUSE BUFFALO HARTFORD ROCHESTER

Prices on LOW NEW LATHES LOW

13" x 6' Willard geared head lathe with quick change gear. A dandy tool value.
16" x 8' Springfield "Ideal" quick change gear lathe with double back geared head.
18" x 8' W. F. & John Barnes Screw Cutting Lathe. The price is surprisingly low.
18" x 10' South Bend Lathe.
21" x 10' South Bend Lathe.
24" x 12' South Bend Lathe.

YOU CAN HAVE PRICES BY RETURN MAIL

THE E. L. ESSLEY · MACHINERY · CO
551-57 W. Washington Blvd., Chicago

Bargains in Radial Drills

2—2½' Standard type, heavy duty, gear drive, MUELLER radial drills.

1—4' Standard type, heavy duty, gear drive, MUELLER radial drill.

Machines practically new. Latest pattern.

WRITE OR WIRE FOR PRICES

The Mueller Machine Tool Co.
Radial Drills and Lathes
CINCINNATI Est. 1902 OHIO, U. S. A.

Priced Right for Present Conditions

A FEW OF OUR BARGAINS IN USED MACHINERY

1—16 x 6 LeBlond Engine Lathe quick change, taper attachment, and draw-in attachment with collets.
1—26 x 6' Pond Planer.
1—No. 4 Cincinnati Plain Miller.
No. 4 Cinti. Miller, belted motor att. and vertical att.
1—26 x 6' Hendey Planer.
1—28 x 14' Pratt & Whitney Lathe.
1—42 x 12' Niles Planer.
1—Bradford 18 x 8' Standard Engine Lathe, SBG, CR.
1—LeBlond Universal Cutter Grinder
1—2" Cleveland Automatic Screw.
1—No. 4 LeBlond Plain Miller.
1—Davis 5" Double C.O. Machine.
2—No. 3—26" Brown & Sharpe Automatic Gear Cutter.
1—No. 13 Brown & Sharpe Spur and Bevel Gear Cutter.
1—No. 4 Warner & Swasey Geared Friction Head Turret Lathe.
1—No. 11 Pratt & Whitney Multiple Drill with (12) ¼" spindles and (8) ⅝" spindles.
1—30 x 30 x 8' Gray Planer. New.
1—No. 2 LeBlond back geared Miller
1—2½' Bickford Radial Drill.
1—No. 35 Giddings & Lewis Horizontal Boring Machine.
1—3' Hilbert Plain Radial, speed box and tapping attachment.
1—No. 16 Brown & Sharpe 10 x 72" Plain Grinder. Excellent.
1—3' Bickford Cone Radial.
1—5' Niles Universal Radial.
1—3/16" A.D.T. Shuster Riveting Machine.

The E. A. Kinsey Co., Cincinnati, Ohio. Indianapolis, Ind. Hamilton, Ohio

---

MACHINERY'S GREEN SECTION is different

The commonplace and dullness of the usual used-tool sections have disappeared in the GREEN SECTION. Atmosphere has been created which lifts the long lists of tools appearing here, out of the ordinary class and puts them before the buyer in a new dress—attractive and unique.

On the first page is a classified index of dealers and manufacturers offering used machines for sale. Consult it.

The Market Place for Buyers and Sellers of Used Tools

H. F. ALLEN CO.

Incorporated
30 CHURCH ST. NEW YORK, N. Y.

24" American Shaper, single pulley drive.
15" Smith & Mills Shaper.
20" Ohio Shaper.
No. 1 Warner & Swasey H. S. Mach.
No. 2 Warner & Swasey H. S. Mach.
⅝" Pratt & Whitney H. S. Machine.
9" x 4' Star Lathe.
11" x 5' Star quick change gear lathe.
13" x 6' Star Lathe.
20" x 10' Greaves-Klusman quick change gear lathe.
2-spindle Allen B. B. Drill.
4-spindle Allen B. B. Drill.
1-spindle Taylor & Fenn Drill.
36" x 36" x 12' Power Planer, 4 heads.
No. 4 Cincinnati Plain Miller, single pulley drive.
12" x 6' Reed Lathe, taper attachment.
2½" x 26" Pratt & Whitney Flat Turret Lathe.
2—25 lb. Fairbanks Power Hammers.
2—20" Blount Wet Tool Grinders.

FOR SALE

Chicago Flexible Shaft Company's No. 35, heat treating oven, 3'x5'x 18", equipped for gas, practically new.

Chambers, Bering, Quinlan Co., DECATUR, ILL.

No. 2 Cincinnati H.P. Vert. Miller.
Model "B" Becker Vert., Miller, S.P.D.
5-C Becker Vert. Miller, Rot. Table.
No. 3 Hendey Plain Miller.
30" Bullard Vertical Boring Mills.
48" Bickford Vert. Boring Mill, 1 Hd.
72" Betts Vert. Boring Mill, 2 Hds.
90" Niles, Vert. Boring Mill, 2 Hds.
10—12" Dill Universal Slotter.
21" Cincinnati Drill Press, T.A.
4" Jarecki Pipe Machine, Cap. 1" to 4".
8" Cox Pipe Machine, Dies 2½" to 8".
12" Merrill Pipe Mach., Cap. 2½" to 12"
No. 5 L.-J. O.B.I. Press, 4" Stroke.
No. 73 Consolidated O.B. Press, 2½" str.
No. 74 Consolidated O.B. Press, 2½" str.
No. 65 Consolidated Geared Press, 5" str.
No. 23 Stoll Horning Presses.
Cleveland Punch, 24" thr., ¾"x¾", M.D.
Cleveland Punch, 15" thr., 1¼"x1", M.D.
No. 38 L.&A. Alligator Shear, Cap. 1¾".
96" Stoll, Sq. Shear, 16 Gauge Cap.
4" Ajax Upsetter, Steel Bed, Side Shear.
No. 5 Williams & White Bulldozer.
6" x 6" Peerless High Speed Saw.
24" x 12" Rahn & Larmon Q.C.G. Lathe.
30" x 12' Johnson Triple Geared Lathe.
30" x 16' New Haven Lathe with Chuck.
No. 2 Warner & Swasey Screw Machine.
No. 2 Foster Screw Machine.
16" x 16" x 4' P. & W. Planer, 1 Hd.
40 lb. Bradley Cushioned Helve Hammer.
50 lb. Fairbank Pat. Upright Hammer.
100 lb. Fairbanks Pat. Upright Hammer.

Reliance Machinery Sales Co.
1407-09 Brighton Road,
Pittsburgh, Pa.

Automatic Screw Machines

ALL SIZES, TYPES AND MAKES
Factory Rebuilt

CINCINNATI AUTOMATIC MACHINE COMPANY
CINCINNATI, OHIO

A Message from Boston

B. C. Ames No. 3 Precision Bench Lathes
Van Norman No. 5½ Precision Bench Lathe
Cincinnati, Barnes, Snyder and Prentice Upright Drilling Machines, 20" to 28"
Henry & Wright Ball Bearing Sensitive Drilling Machines, one, three and four spindles
Taylor & Fenn 3 ft. Sensitive Radial Drilling Machine
18" and 36" Becker-Brainard Automatic Gear Cutters
Norton 6" x 32", 10" x 36" and 10" x 50" Plain Grinders
Cincinnati, LeBlond & Wells Cutter Grinders
Lathes:—American, Carroll-Jamieson, Fay & Scott, Flather, Hendey, Lodge & Shipley, Rockford, South Bend, 12" x 5' to 20" x 8'
Milling Machines:—Brown & Sharpe, Cincinnati, Milwaukee, Kempsmith; plain, universal and vertical.
Shapers:—Steptoe 14", American 15"

Our Blue List No. 11 tells the whole story

HILL, CLARKE & CO., Inc.
The Machinery Merchants Since 1864
156 Oliver Street Boston 9, Mass.

THE OSBORNE & SEXTON MACHINERY COMPANY

COLUMBUS DEPT. M. OHIO

Band Saw, metal Kiemen, 12".
Bending Rolls, 7 for ⅜" plate.
Boring Mill, Colburn 30", 54" and 62", 2 heads.
Brake, Keene 10-ft. 18 gauge hand operated.
Compressors, 5 x 4, 8 x 8 and 12 x 10.
Drills, Barnes 20", 24" and 26", all geared.
Drills, Sliding Head, 24, 26, 28 and 32".
Gear Cutter No. 3 B. & S. 26".
Gear Millers, Automatic, Bilton No. 1 (5).
Grinders, Plain, 10x24 Norton and 12x36 Landis.
Grinders, Surface, 1, 3 and 78 Wilmarth & Morman.
Grinder No. 20 Bryant, Deep Hole Chucking.
Grinder, Universal, 12 x 36 Cincinnati.
Grinders, 12" x 72" Brown & Sharpe, plain.
Grinder, No. 4 Gardner double disc, 20" dia. discs.
Hammer, 40 lb. Bradley Cushioned Helve.
Lathes, 14" x 6' and 18" x 8' Monarch.
Lathe, 18" x 10' American, quick change.
Lathe, 25" x 14' Schummacher-Boye.
Milling Machine No. 1 B. & S. Universal.
Milling Machines, No. 2-A and 4-B Becker Vertical.
Milling Machine No. 2 heavy Brown & Sharpe Pl.
Milling Machines No. 3 LeBlond, plain.
Planer, 24 x 24 x 6' Gray, single head.
Planer, 60" x 60" x 17' Betts.
Planer, 36" x 36" x 10' Cincinnati, 2 hds.
Presses, No.1 1500 lb.; No. 2½ 3000 lb. Robinson.
Punch and Shear, ½ x ½—10" throat.
Pipe Machines, 2", 4", 6" and 12".
Radials, 3' and 4½' Morris Plain, gear box.
Riveter No. 3A High Speed (2).
Screw Machines, National Acme, Nos. 52 and 56.
Scleroscopes, Shore style "C" complete (2).
Shapers, 14" Niles, traveling head.
Shapers, 14", 16" and 21" Smith & Mills.
Shear Quickwork 14" gauge, 30" and 60" throat.
Shear 5' Robinson, 10 gauge.
Slotter, 18" Bement-Miles circular table.
Squaring Shear, 10' 18 gauge metal.
Turret Lathe, 1" and 1⅝" Millholland.
Turret Lathe, 1½" Friction Back Geared, Wood.
Turrets, 2x24 and 3x36 J & L Single Pulley.
Turret Lathe, 24" Steinle.

NEW 3 PHASE MOTORS 5 H.P., $67.50, 3 H.P., $57.50

BORING MILLS
No. 1 Beaman & Smith hor. floor type spdl. 3"
51" Bullard Vertical.
72" Bullard, 2 swivel heads, arr. M.D.

BROACHING MACHINES
No. 2 J. N. Lapointe Co., stroke 52".

DIE SINKER
No. 2 Pratt & Whitney, latest model.

DRILLS, SENSITIVE
Avey No. 3 single spindle, B.B., 1½".
Leland-Gifford sgl. spdl. B.B., 14", No. 2 taper
Taylor & Fenn single spindle, B.B., ¾".
Allen 2 spindle, P.B.
Henry & Wright 3 spindle, Class B, B.B.
H. G. Barr 4 spindle, P.B.

HAMMERS
25 lb. Bradley Helve.
50 lb. Bradley Compact.

PROFILERS
No. 0 Bickett Vertical, D. I. Att.
No. 12 Pratt & Whitney, 2 spdl., latest type.

SHAFT STRAIGHTENER
No. 3 Corey, 6".

SHAPERS
24" Hendey Friction Power down feed.
20" Walcott, single geared.
15" Perkins Friction.
10" Pratt & Whitney, single geared, crank.
16" American crank, not B.G., swivel vise.

SHEARS
No. 3 Ryerson Quintuple Combination Punching and Shearing, Steel Frame, High Power. Get the details of what this unusual machine will do.
No. 2 Ryerson "Lennox" Rot. Bev. Shear, ¾"

LATHES, TURRET
No. 6 Warner & Swasey Universal, BG, 2½", HEAVY DUTY CARRIAGE.

LYND-FARQUHAR CO.
425 Atlantic Ave., BOSTON, MASS.

Presses and Square Shears

3 No. 15 Robinson Horning Presses
5 No. 20 Bliss O. B. Inc. Presses
2 No. 2 Robinson O. B. Inc. Presses
No. 2 and No. 3 Toledo O. B. Inc.
No. 3 and No. 4 Niagara O. B. Inc.
No. 236 36" Niagara Shear 18 g.
72" Bliss 6" Gap ¼" Capacity.
10' Ohl Shear, 14 Gauge.
No. 411-1 Toledo 11 Gauge Cap.
No. 2½ LeBlond Universal Miller.
200 other High Grade Tools to select from

Wire or Write for Bargain Prices

JONES MACHINE TOOL CO., Cincinnati, Ohio

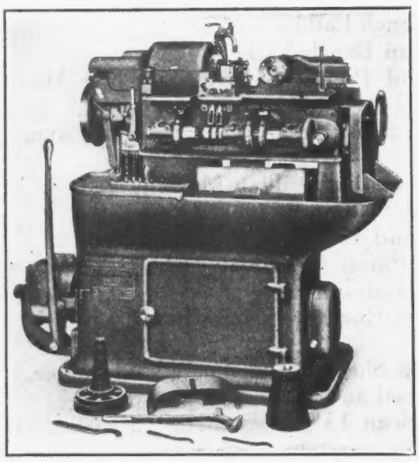
Miles Saves You Money
On High Grade Tools

10' Betts boring and turning mill
42" Gisholt boring and turning mill
No. 3 Cincinnati vertical miller
No. 2 Cincinnati plain miller
20" x 8' American lathe, Q.C.G.
10" Pratt & Whitney vertical shaper
27" x 16' Prentice geared head lathe
48" x 48" x 14' Powell 4-head planer
24" and 36" Bullard vertical turret lathes
No. 3A Universal boring mill, 3" bar

MONEY BACK GUARANTEE

Miles Machinery Co.
Saginaw, Mich.

4-No. OG B. & S. Automatic Screw Machines



Late Type Self-Contained Machines

Single clutch pulley drive. With 6-hole turret, dia. of holes ¾"; hole through largest feeding finger ⅛"—through feed tube 17/32"; turns lengths to 2"; feeds length to 3"; net weight, about 2125 pounds.

Equipped with tank, piping, pump, change gears, feed tube and wire stand.

CONDITION FULLY GUARANTEED. Price, each, F.O.B. Bridgeport **$975**

We also have right in our stock some No. 00, No. 0 and No. 2 BROWN & SHARPE FULL AUTOMATIC SCREW MACHINES, and some CUTTING OFF and TURRET FORMING MACHINES. Any of these would be sent out with a satisfaction guarantee

LUCAS MACHINERY SERVICE

J. L. LUCAS & SON Inc

BRIDGEPORT, CONN.

Real Values in Rebuilt Machine Tools

No. 3B Nazel Air Hammer, direct motor drive, practically new.
No. 23 New Britain Automatic, A1 condition.
No. 5 Williams & White Bulldozer.
No. 90 Williams & White Belt Driven Power Hammer.
No. 2 Cinci. Univ. Miller, cone type, complete.
No. 2 Brown & Sharpe Universal Miller, cone type, complete.
No. 2A Warner & Swasey Universal Hollow Hexagon Turret, geared head.
3½" Acme Flat Turret Lathe, geared head.
No. 4 Warner & Swasey Turret Screw Machine, power feed to cross slide.
36" x 22' Putnam Triple Geared Lathe, semi-quick change.
36" x 14' LeBlond standard change gear lathe.
30" x 12' LeBlond heavy duty quick change gear lathe.
34" x 12' Rahn & Larmon quick change gear lathe with taper.
20" x 12' Bradford quick change gear lathe.
19" x 10' LeBlond heavy duty quick change gear lathe.
18" x 10' Greaves & Klusman quick change Lathe with apron control.
16" x 6' American Tool Works eight speed geared head quick change lathe.
14" x 6' Lodge & Shipley quick change lathe.
12" x 6' Hendey Machine Co.'s quick change lathe with yoke head.
No. 3B Heavy Brown & Sharpe Plain Miller, single pulley.
No. 3 Kempsmith Plain Miller, cone type.
No. 2B Brown & Sharpe Plain Miller, single pulley.
No. 0 Cincinnati Plain Miller, cone type.
No. 6 Whitney Hand Miller.
5' Niles, Bement & Pond Full Universal Radial Drill gear box drive.
4' Western Plain Radial Drill gear box drive, late type.
3' Western Plain Radial Drill gear box drive, late type.
2½" Cinti Bick. Pl. Radial Drill gear box dr.
26" Cinti Bickford Upright Drill gear box dr.
24" Aurora Upright Drill, back geared, wheel, lever and power feeds.
22½" Barnes Upright Drill, back geared, wheel, lever and power feeds.
20" Barnes four spindle drill press with automatic approach and return feeds.
2 spindle Allen High Speed Sensitive Drill Press, ball bearing with 7" overhang.
14" Henry & Wright High Speed Sensitive Drill Press, ball bearing.
24" Cincinnati B.G. crank shaper, cone drive.
20" American Tool Works, back geared crank shaper, cone drive.
20" Smith & Mills B.G. Crank Shaper, cone dr.
15" Hendey Friction geared shaper.
26" x 26" x 6' Cinti Planer, belt drive with two heads on rail.
No. 60 Head Cyl. Grinder, complete, ser. 1470
6" x 18" Landis Plain self-contained Grinder.
11" Gleason Automatic bevel gear generator.
3—36" Brown & Sharpe Auto. Gear Cutter.
1½" Acme single head bolt cutter with dies and countershaft.
No. 21 Lucas Horizontal Boring Mill gear box drive with 2¾" bar.
18" Besley Disc Grinder with one lever feed and one plain tilting table.
And Many Others. Send for our Complete Bargain List of rebuilt tools, and save money.

EASTERN MACHINERY CO.
408 E. Pearl St. Cincinnati, Ohio

Toledo No. 666 Knuckle Joint Press.
Toledo No. 59¼ Straight Side Press.
Toledo 35-P and 36 Grd. Presses.
Bliss Toggles Nos. 1½, 3½-A, 3½-C.
Warner & Swasey No. 4 Universal.
Warner & Swasey No. 6 Turret Lathes.
Warner & Swasey No. 3-A Universal.
Ferracute P-4 and PG-5 Presses.
Libby 18" and 26" x 7½" hole Lathes.
Bullard 24" Vertical Turret Lathe.
Beaudry 250-lb. Upright Power Hammer.
Garvin Nos. 2 and 2-B.G. Tappers.
Acme Bolt Cutters, 2½" Sgl., 1" Dbl.
Brown & Sharpe 3-A Universal Miller.
Foote-Burt No. 17 Adj. 4 spindle drill.
Williams & White, 2, 3 and 4 Bulldozers.
Draw Benches, 25,000 and 15,000 lb. cap.
Geo. A. Ohls 8'6" Brake, 10 gauge cap.
Ajax 4" Upsetter, Steel Bed.
Partial List.

D. C. OVIATT & COMPANY
1108 St. Clair Ave., Cleveland, Ohio.

Surplus Equipment For Sale By User

2—No. 1 Foster screw machines.
1—No. 2 Wood tilted turret screw mch.
1—No. 107 Wells screw machine.
1—No. 1 Wood tilted turret screw mach.
2—No. 1 Brown & Sharpe semi-automatic screw machines.
1—No. OG Brown & Sharpe automatic screw machine.
1—No. 2 Brown & Sharpe automatic screw machine.
1—No. 1 Detroit 5 spdl. semi-automatic drilling machine.
1—No. 3A B. & S. univ. milling mach.
1—No. 3 Bridgeport safety wet grinder —floor type.
1—New Yankee drill grinder.

Harvard Electric Co.
2620 W. Flournoy St., Chicago, Illinois

WANTED TO BUY—Pratt and Whitney No. 2 Die Sinker in good condition.

Address Mr. Walcott,
Helburn Thompson Company,
18 Goodhue Street, Salem, Mass.

WANTED TO BUY

4-spindle Leland-Gifford Drill.
2B or 3B Univ. Kearney & Trecker Mill. Mach.
18" Libby or Warner & Swasey Turret Lathe.
Deep Throat Toledo Punch Press.
Floor Type Filing Machine.
No. 7 or equivalent Gardner Disc Grinder.

Box 745, care MACHINERY
148 Lafayette Street, New York City

WANTED TO BUY

A Used Olsen Testing Machine, or similar make, 100,000 to 200,000 capacity. Must be in A-1 condition.

Box 747, care MACHINERY
148 Lafayette Street New York City

WANTED TO RENT

Two 100 H.P. Double Drum Hoisting Engines

equipped with 100 H.P., 220 volts A.C., 2 phase, 60 cycle motors.

HAY FOUNDRY & IRON WORKS,
72 Roanoke Ave., Newark, N. J.

WANTED

Milling Machines, all types and size S.P.D.; B & S Automatics, Center Lathes, S.P.D.; Gear Cutters, Rochester Riveters, Grinding Machines, Drilling Machines, etc., all in first class condition, state rock-bottom price for immediate purchase.

Box 748, care MACHINERY,
148 Lafayette St., New York.

WANTED

6000 lb. Erie Hammer

in good condition. Give price and location for inspection.

Address Box 746, care MACHINERY
148 Lafayette Street New York City

What Machines Do You Want?

MACHINERY has helped many of its readers by placing them in touch with dealers having just the type of used machines wanted. Consult the pages of the GREEN SECTION first, and if what you want is not advertised—write MACHINERY'S Inquiry Department. There is no charge for this service—we want to help you.

8-24

MACHINERY'S Green Section,
140-148 Lafayette Street, New York City. Date.....

I should like particulars in regard to the following used machine tools:.....

Name.....

Address.....

Just one of the family

A sample for test purpose is yours for the asking.

The Mac-it Safety-Hollow Screw

is just one of the "Mac-it" family, but by no means the least where importance is concerned.

A safety screw or danger eliminator, invaluable for use in the moving parts of machinery, and where frequent adjustment is necessary.

Made in sizes from ¼" to 1½" diameters. Furnished with either plug or angle wrenches.

Other types: SET SCREWS, square, headless, tool post. CAP SCREWS, hex head, square head, filister head, round head, flat head, button head. Also SILVER BAND PUNCHES.

THE STRONG, CARLISLE & HAMMOND COMPANY

General Distributors, **1392-1394 West Third Street, CLEVELAND, OHIO**

Stop Cutter Breakage with Red-E Tool Holders

You can soon buy a few more, with the money one Red-E Tool Holder saves. Try it.

Cutters break because tool holders wear down. Red-E Tool Holders have a tool steel insert under the cutter which minimizes wear and thereby prevents cutter breakage. Give your cutters a chance to *wear out from work*—buy a few Red-E Tool Holders from your dealer—do away with broken tools in your scrap pile—save some of the money you are now spending for tools.

Send for Catalog M-20. It tells all about the Red-E line.

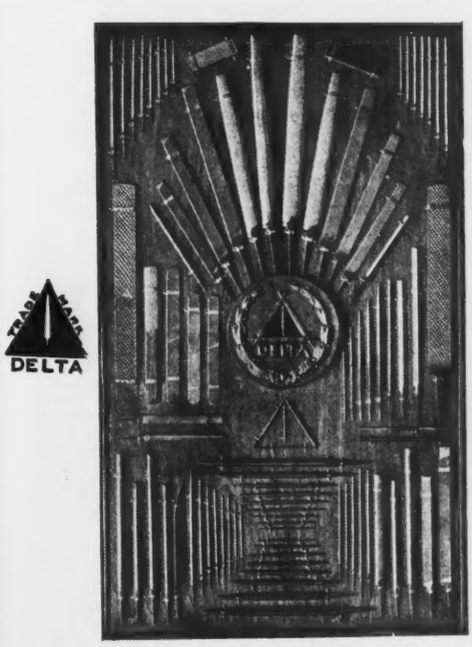
The Ready Tool Co.

Iranistan Ave., Bridgeport, Conn.

RED E TOOLS

THE WINNERS

Used in Every Shop Where Economy and Efficiency Are Practiced



The File you will eventually use—as perfect as will and skill can make—clean, strong, sharp teeth

DELTA FILE WORKS

PHILADELPHIA, U. S. A.

Used in Every Shop Where Economy and Efficiency are Practiced

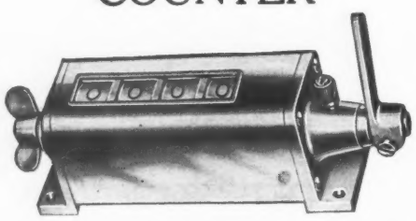
Will Work Out like an Employment Standard

In a battery of presses there may be no difference in the machines; no disparity in the skill of the operators; no reason why all can't produce alike.

Yet what a difference in the *output* of the different units! Between high man and low man, what a costly deficiency in work!

Suppose you make the record of the *busiest* machine, the standard for *ALL* the machines! Let that show the production a *qualified* workman must register, on a

Veeder
COUNTER



The above *Set-Back Rotary Ratchet Counter* counts one for each oscillation of the lever, as required in counting the product of presses and metal-stamping machinery. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as needed. Price, with four figures as illustrated, $11.50 (subject to discount). Equipped with lock and keys to prevent tampering with the record, $2 extra. (Cut ½ size.) Set-back *Revolution* Counter of similar model, price $10 (list).

Here's the new specialized Punch Press Counter; a heavy-cased ratchet mechanism, immensely durable.

Built especially for recording the product of heavy-duty machinery where a reciprocating movement registers an operation. Strong stops limit the movement of the lever to 45 degrees or ⅛ turn, which registers one on the dial. The large, legible figures are easily read ten feet away. Counter is regularly furnished with five figure-wheels, and may be *set back to zero* by one turn of knob. Requires no special fixtures for attaching. Price $18.00.

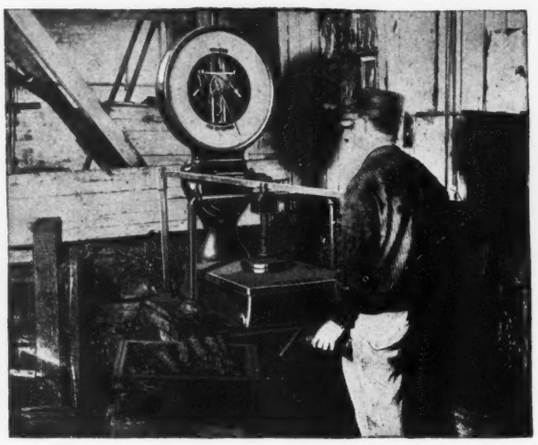
Write for the 80-page Veeder booklet.

The Veeder Mfg. Co.

39 Sargeant Street, Hartford, Conn.

Middle West Distributor
F. A. BRINGOLF
549 Washington Blvd.
CHICAGO, ILL.

Pacific Coast Distributor
F. SOMERS PETERSON CO.
57 California St.
SAN FRANCISCO, CAL.



USING this No. 801 style Toledo, installed in the plant of Kokomo Spring Co., one man tests and sorts 8000 valve springs daily.

With the old style scale previously used, two men tested and sorted only 3000 springs daily.

A net saving of more than ten dollars a day.

There is a Toledo Scale—automatic, accurate, durable—for every weighing requirement.

Toledo Scale Company. Toledo. Ohio
Canadian Toledo Scale Co. Limited. Windsor. Ontario
Largest Automatic Scale Manufacturers in the World
106 Sales Rooms and Service Stations in cities in the United States and Canada-Others in thirty-four foreign countries

Reads in Ten-thousandths

LAST WORD
MODEL-D-10

H. A. LOWE, 1874 East 66th Street
CLEVELAND, OHIO

ANCHOR PRODUCTS
include
HIGH SPEED AND CARBON STEEL DRILL RODS
OPEN HEARTH DRILL RODS; ALLOY TAP STEEL
SPECIAL SHAPES IN ALLOY AND CARBON TOOL STEELS
Let us quote you
ANCHOR DRAWN STEEL CO., LATROBE, PA.

Look out for the October Number of MACHINERY —It will interest you.

CLASSIFIED ADVERTISEMENTS

SITUATIONS, HELP WANTED, FOR SALE, ETC.

Advertisements in this section, 25 cents a line, seven words to a line—minimum, $1.50. The money should be sent with the order. Answers addressed to our care will be forwarded. Original letters of recommendation should not be enclosed to unknown correspondents.

HELP WANTED

WE DESIRE THE SERVICES OF HIGH-GRADE SALESMEN, thoroughly familiar with power presses as used by producers of drawn metal work. State experience in detail. See display advertisement. R. D. KING, Chicago, Ill.

WANTED—Salesmen who know machine tools, shop methods and can produce. In replying give experience, reference and compensation expected. Box 750, care MACHINERY, 148 Lafayette St., New York.

SALESMAN—Mechanical engineer preferred. Must have good mechanical judgment. To sell Conway Clutches. Openings in several large industrial centers. Commission basis. Address: CONWAY CLUTCH CO., 1946 West 6th St., Cincinnati, Ohio.

WANTED—Two experienced grinding wheel salesmen for the middle west section by an established wheel company whose product is well and favorably known. There is an established trade in sections to be covered and local stock is carried. In replying kindly give full particulars as to past experience. Box 752, care MACHINERY, 148 Lafayette St., New York.

EXECUTIVES, ENGINEERS, $3000-$25,000, will find our individual, confidential service an effective and dignified medium to make connections desired. Since 1919 personally conducted by Mr. JACOB PENN, the eminent employment authority, known to leading business men throughout America. Not employment agency. **Inquiries solicited only from persons with records of successful performance and stability.** JACOB PENN, INC., 305 Broadway, New York.

MACHINE DESIGNER—Must be a high grade man with at least six to eight years of experience on designing automatic machinery. One interested in machine development who has original ideas concerning machine movements, can calculate stress and strain, figure the size of any member and who understands working limits. Location, Chicago. When answering give age and education, also a complete outline of experience. State salary expected. Box 739, care MACHINERY, 148 Lafayette St., New York.

SITUATIONS WANTED

EXECUTIVE—Expert tool diemaker, 28 years' broad practical experience on fine machinery and interchangeable parts. Had charge of both tool and production department. Also highest references as general foreman. Worth investigating. Box 751, care MACHINERY, 148 Lafayette St., New York.

GENERAL FOREMAN, of ability and initiative desires connection with manufacturing concern. 6½ years toolmaking, 2½ years timing and adjusting production, 4 years as department foreman. References as to ability and deportment. Trained mechanically and technically Now employed. Box 753, care MACHINERY, 148 Lafayette St., New York.

ASSISTANT MANAGER OR SUPERINTENDENT—Graduate mechanical engineer. Machinist and foreman six years. Designer, engineer, executive and superintendent six years. Seeks permanent connection. Available now. Box 754, care MACHINERY, 148 Lafayette St., New York.

PATENTS

PATENTS SECURED—C. L. PARKER, Ex-member Examining Corps, U. S. Patent office. Instructions upon request. McGill Bldg., Washington, D. C.

PATENTS—H. W. T. JENNER, patent attorney and mechanical expert, 606 F St., Washington, D. C. Established 1883. I make an examination and report if a patent can be had, and the exact cost. Send for full information. Inventors assisted in developing ideas and inventions.

FOR SALE

FOR SALE—Tool-room located in large city of Central New York. Modern in every respect. Entire equipment as good as new. Doing fine business. Address Box 727, care MACHINERY, 148 Lafayette St., New York.

FOR SALE

FOR SALE—A complete set of Watchmakers' tools at a bargain. R. JAEGERMANN, 5815 Easton Ave., St. Louis, Mo.

FACTORIES FOR SALE OR LEASE—Have professional engineers with extensive plant experience and who can therefore better appreciate your requirements, aid you in locating a suitable factory. TECHNICAL SERVICE CO., Woolworth Bldg., New York City, Whitehall 5690.

WANTED—Toolmakers and machinists attention! Do you want to increase your salary? Saunders' enlarged Edition Hand Book Practical Mechanics written by a machinist will do it, because it fills the bill for a ready reference shop kinks, quick methods, simple arithmetic. Price, $1.50. Why pay more? Agents wanted, circular on request. E. H. SAUNDERS, 31 Bay State Road, Boston, Mass.

EMPLOYMENT SERVICE

EXECUTIVES—Qualified men—Technical, Commercial or Manufacturing—seeking new positions find our effective and confidential service extremely satisfactory. Our Mr. H. H. Harrison can negotiate a suitable connection for you as he has done for thousands of others since 1909. Inquiries invited; confidence respected. THE NATIONAL BUSINESS BOURSE, INC., Confidential Negotiators, Association Bldg., Chicago.

Salaried positions $2,500 to $25,000 upward; executive, technical, administrative, engineering, manufacturing, professional, managing, financial, etc., all lines. If you are qualified, and receptive to tentative offers for a new connection, you are invited to communicate in strict confidence with the undersigned, who will conduct preliminary negotiations for such positions. A method is provided through which you may receive overtures in confidence, without jeopardizing present connections, and in a manner conforming strictly to professional ethics. Send name and address only; preliminary particulars will be sent without obligating or compromising you in any way. R. W. BIXBY, INC., 409 Lockwood Building, Buffalo, N. Y.

New Product Wanted

to manufacture by Philadelphia Machine Builders, established 70 years and well known in Electrical Industry. Preferably a mechanical product already on the market, selling to manufacturers, jobbers, or consumers, which can be made in quantity and which requires a minimum of sales service. No household appliances considered.

Box No. 749,
care MACHINERY, 148 Lafayette Street,
New York.

ALFRED HERBERT, LTD.

COVENTRY, ENGLAND.

We possess exceptional facilities for the sale of Engineering goods of every description throughout the world and are prepared to negotiate for sole agencies.

We and our Associated Companies have offices, and in many cases showrooms, in the following territories:

GREAT BRITAIN: Coventry, London, Birmingham, Manchester, Glasgow, Sheffield, Leeds, Bristol, Newcastle.
FRANCE: Soc. Anon. Alfred Herbert: Paris, Lyons, Lille.
BELGIUM: Soc. Anon. Belge Alfred Herbert: Brussels.
INDIA: Alfred Herbert (India), Ltd.: Calcutta, Bombay, Madras, Lahore, Rangoon, Delhi.
ITALY: Soc. Anon. Ital. Alfred Herbert: Milan.
AUSTRALIA: Alfred Herbert (Australasia), Ltd.: Sydney.
JAPAN: Osaka.
ARGENTINE REPUBLIC: Buenos Aires.

What Industry Doesn't Need Them?

Have you seen the double pick counter made by Root?

None—providing you want to know facts. Whatever you make, it needs tallying—*ask*

The Root Co.
BRISTOL, CONN.

PATENTS

C. L. PARKER
Ex-Member Examining Corps,
U. S. Patent Office

Attorney-at-Law and Solicitor of Patents

American and Foreign Patents secured. Searches made to determine patentability, validity and infringement.

Handbook for Inventors sent upon request.

McGill Building **WASHINGTON, D. C.**

MACHINERY'S PRODUCT INDEX

FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX SEE ALPHABETICAL INDEX, PAGES 267-268.

ABRASIVE CLOTH AND PAPER
Carborundum Co., Niagara Falls, N. Y.

ACCUMULATORS, HYDRAULIC
Bethlehem Steel Co., Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Eng. Works, Charles F., 222 North Morgan St., Chicago.
Farrel Fdry. & Mch. Co., Inc., Buffalo, N. Y.
French Oil Mill Machinery Co., Piqua, Ohio.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

ACETYLENE APPARATUS
Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.

ACETYLENE, DISSOLVED
Air Reduction Sales Co., 342 Madison Ave., New York.
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York.

AIR HOISTS
See Hoists, Air.

ALLOYS, TUNGSTEN, URANIUM, VANADIUM, MOLYBDENUM, ALUMINUM, ETC.
Baush Machine Tool Co., Springfield, Mass.
Haynes Stellite Co., 30 E. 42nd St., New York.
Vanadium Alloys Steel Co., Latrobe, Pa.

ANGLE PLATES, UNIVERSAL
Boston Scale & Mch. Co., Roxbury, Mass.
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.

ANVILS
Columbian Hardware Co., Cleveland.
Yost Mfg. Co., Meadville, Pa.

ARBOR PRESSES
See Presses, Arbor.

ARBORS AND MANDRELS, EXPANDING
American Broach & Machine Co., Ann Arbor, Mich.
Eastern Tube & Steel Co., Brooklyn, N. Y.
McCrosky Tool Corp., Meadville, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Western Tool & Mfg. Co., Springfield, Ohio.
Whitman & Barnes Mfg. Co., Akron, Ohio.

ARBORS AND MANDRELS, SOLID
American Broach & Mch. Co., Ann Arbor, Mich.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Pratt & Whitney, Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

BABBITT
Ajax Metal Co., Philadelphia, Pa.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Doehler Die Casting Co., Brooklyn, N. Y.
Hoyt Metal Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

BABBITTING LUTE
Products Mfg. & Sales Co., Milwaukee, Wis.

BALANCING EQUIPMENT
Anderson Bros. Mfg. Co., Rockford, Illinois.
Divine Bros. Co., Utica, N. Y.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Norton Co., Worcester, Mass.
Rockford Tool Co., Rockford, Ill.

BALLS, BRASS, STEEL, ETC.
Abbott Ball Co., Elmwood, Hartford, Conn.
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Gwilliam Co., Brooklyn, N. Y.
Hider Steel Ball Works, Binghamton, N. Y.
Hoover Steel Ball Co., Ann Arbor, Mich.
S K F Industries, Inc., 165 Broadway, New York.
Skayef Ball Bearing Co., 165 Broadway, New York.

BARS, BORING
See Boring Bars.

BARS, PHOSPHOR BRONZE
Bunting Brass & Bronze Co., Toledo, Ohio.

BEARINGS, BABBITT
Bunting Brass & Bronze Co., Toledo, Ohio.
Franklin Die-Casting Corp., Syracuse, N. Y.
Hoyt Metal Co., St. Louis, Mo.
Link-Belt Company, Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, BALL
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Ball Bearing Co., Bantam, Ct.
Bearings Co. of America, Lancaster, Pa.
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Breakstone, S., 63 E. Harrison St., Chicago.
Cresson-Morris Co., Philadelphia.
Fafnir Bearing Co., New Britain, Conn.
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Gwilliam Co., Brooklyn, N. Y.
Marlin-Rockwell Corp., Jamestown, N. Y.
New Departure Mfg. Co., Bristol, Conn.
Norma Co. of America, Long Island City, N. Y.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.
Strom Ball Bearing Mfg. Co., 4563 Palmer St., Chicago.
Torrington Co., Torrington, Conn.

BEARINGS, BRONZE
Ajax Metal Co., Philadelphia.
Besly & Co., Charles H., 12-B North Clinton St., Chicago.
Bunting Brass & Bronze Co., Toledo, Ohio.
Hoyt Metal Co., St. Louis, Mo.

BEARINGS, LINESHAFT
Adamson Mch. Co., Akron, O.
Hyatt Roller Bearing Co., Newark, N. J.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, OILLESS
Arguto Oilless Bearing Co., 145 Berkley St., Wayne Junct'n, Philadelphia

BEARINGS, ROLLER
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Ball Bearing Co., Bantam, Ct.
Breakstone, S., 63 E. Harrison St., Chicago.
Gwilliam Co., Brooklyn, N. Y.
Hyatt Roller Bearing Co., Newark, N. J.
Norma Co. of America, Long Island City, N. Y.
Timken Roller Bearing Co., Canton, Ohio.

BEARINGS, SELF-OILING
Link-Belt Company, Chicago.
Skayef Ball Bearing Co., 165 Broadway, New York.
S. K. F. Industries, Inc., 165 Broadway. New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, TAPERED ROLLER
Bock Bearing Co., Toledo, O.
Timken Roller Bearing Co., Canton, O.

BEARINGS, THRUST
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Bantam Ball Bearing Co., Bantam, Conn.
Bearings Co. of America, Lancaster, Pa.
Breakstone, S., 63 E. Harrison St., Chicago.
General Electric Co., Schenectady, N. Y.
Gwilliam Co., Brooklyn, N. Y.
Norma Co. of America, Long Island City, N. Y.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.
Timken Roller Bearing Co., Canton, O.

BELT CEMENT
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.
Williams, I. B., & Sons, Dover, N. H.

BELT CLAMPS
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

BELT DRESSING
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Schieren Co., Charles A., 73 Ferry St., New York.

BELT FASTENERS, LEATHER
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.

BELT FASTENERS, METAL
Bristol Co., Waterbury, Conn.
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Greene, Tweed & Co., 109 Duane St., New York.
Schieren Co., Charles A., 73 Ferry St., New York.

BELTING, LEATHER
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.
Williams, I. B., & Sons, Dover, N. H.

BELTING, ROUND LEATHER
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.
Williams, I. B., & Sons, Dover, N. H.

BELT LACING
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.
Williams, I. B., & Sons, Dover, N. H.

BELT SHIFTERS
Haskins Co., R. G., 518½ W. Monroe St., Chicago.
Kremer-Cummins Mch. Co., Cleveland.
LeBlond, R. K., Machine Tool Co., Cincinnati.
Ready Tool Co., Bridgeport, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

BENCH LEGS
Brown & Sharpe Mfg. Co., Providence, R. I.

BENDING MACHINES, ANGLE IRON
Buffalo Forge Co., Buffalo, N. Y.
Wickes Bros., Saginaw, Mich.

BENDING MACHINES, HYDRAULIC
Bethlehem Steel Co., Bethlehem, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.
Williams, White & Co., Moline, Ill.

BENDING MACHINES, PIPE
Buffalo Forge Co., Buffalo, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Sellers & Co., Inc., Wm., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia.
Underwood Corp., H. B., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

BLOCKS, CHAIN
See Hoists, etc.

BLOWERS
American Gas Furnace Co., Elizabeth, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

BLOWERS, POSITIVE PRESSURE
American Gas Furnace Co., Elizabeth, N. J.
Leiman Bros., 60-62 Lispenard St., New York.

BLUEPRINT DRYING MACHINES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.

BLUEPRINT FILING CABINETS
See Cabinets, Filing.

BLUEPRINT MACHINES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.
Wickes Bros., Saginaw, Mich.

BLUEPRINT PAPER
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.

BOILER TUBES
National Tube Co., Pittsburgh, Pa.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

BOLT AND NUT MACHINERY
Acme Machinery Co., Cleveland.
Ajax Mfg. Co., Cleveland.
Gaterman, W., Mfg. Co., Manitowoc, Wis.
Landis Machine Co., Inc., Waynesboro, Pa.
National Acme Co., Cleveland, O.
National Machinery Co., Tiffin, O.

BOLTS AND NUTS
National Acme Co., Cleveland, O.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

BOOKS, TECHNICAL
Industrial Press, 148 Lafayette St., New York.

BOOSTERS
American Gas Furnace Co., Elizabeth, N. J.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

BORING AND DRILLING MACHINES, VERTICAL
Baker Bros., Inc., Toledo, O.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Bullard Machine Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Ferner Co., R. Y., Washington, D. C.
Foote-Burt Co., Cleveland.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Ingersoll Milling Mch. Co., Rockford, Ill.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

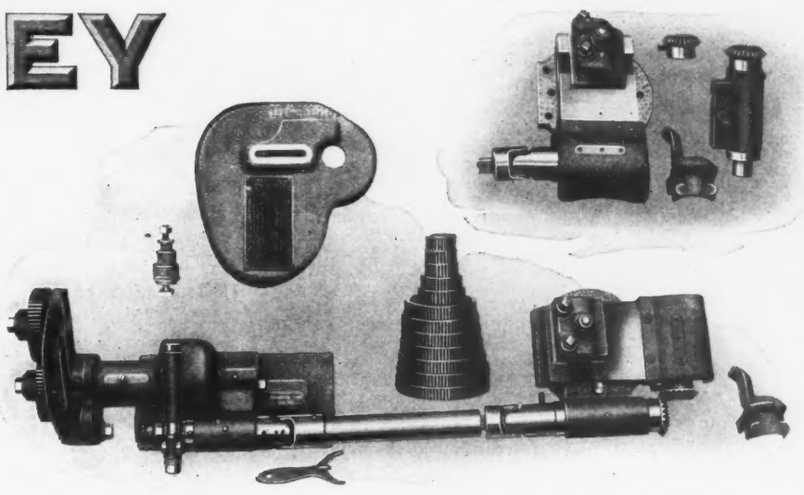
BORING AND TURNING MILLS, VERTICAL
Betts Machine Co., Rochester, N. Y.
Bullard Machine Tool Co., Bridgeport, Conn.
Cincinnati Planer Co., Cincinnati.
Colburn Machine Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Sellers & Co., Inc., Wm., Philadelphia.

BORING BARS
American Hollow Boring Co., Erie, Pa.
Armstrong Bros. Tool Co., 313 No. Francisco Ave., Chicago.
Bullard Machine Tool Co., Bridgeport, Conn.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.

HENDEY

Improved Spiral Relieving Attachment

Type C



Probably the best known and most widely used Lathe Relieving Attachment today. This Attachment relieves Taps, Hobs and other Cutters with spiral or straight flutes, also formed cutters, and operates on internal, angular and end relieving, with equal facility.

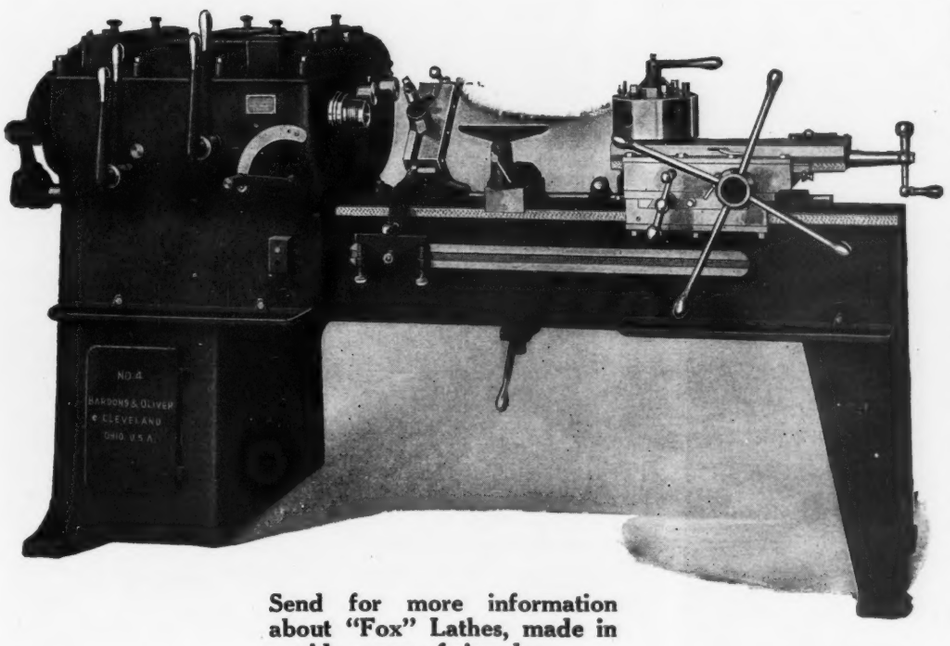
Furnished for all sizes of HENDEY E.B.M. and Cone Head Lathes, 14 inch to 24 inch swing.

THE HENDEY MACHINE COMPANY, Torrington, Conn.

Singer Bldg., New York City. Box 27, Watertown, Mass. 565 Washington Blvd., Chicago, Ill. Commerce Bldg., Rochester, N. Y. 2663 Main St., Buffalo, N. Y.

AGENTS FOR THE HENDEY MACHINE COMPANY, Walraven Co., Atlanta, Ga.; Louis G. Henes, San Francisco, Cal.; Los Angeles, Cal.; W. M. Pattison Supply Co., Cleveland, Ohio; Detroit, Mich.; E. D. Morton & Co., Louisville, Ky.; F. E. Satterlee Co., Minneapolis, Minn.; Woodward, Wight & Co., Ltd., New Orleans, La.; Sherritt & Stoer Co., Philadelphia, Pa.; Laughlin-Barney Machinery Co., Pittsburgh, Pa.; Portland Machinery Co., Portland, Oregon; A. R. Williams Mchy. Co., Ltd., Toronto, Ont.; Manitoba, St. John, N. B.; Vancouver, B. C.; Winnipeg, Williams & Wilson, Ltd., Montreal, Quebec.

"FOX" All-geared Motor Driven LATHES



As complete as lathes can be made! Many features, all modern. Selective speed all-geared head, eliminating overhead shafting. Eight spindle speeds. Chasing and taper attachments. Universal turret slide and saddle with both longitudinal and cross motion.

The "Fox" Lathe may be equipped with automatic chuck and wire feed, as well as power longitudinal feed on turret slide.

Friction clutches give instantaneous reverse, spindle only being reversed while motor and fast-running shafts revolve in only one direction.

Compact construction and motor drive adapt it to the crowded shop —it fits almost anywhere, without regard to line shafting.

Send for more information about "Fox" Lathes, made in a wide range of sizes by

BARDONS & OLIVER, 1133 West 9th St., Cleveland, Ohio

Madison Mfg. Co., Muskegon, Mich.
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Production Engineering Corp., Canastota, N. Y.
Ready Tool Co., Bridgeport, Conn.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Underwood Corp., H. B., Philadelphia.
Williams, J. H., & Co., Buffalo, N. Y.

BORING, DRILLING AND MILLING MACHINES, HORIZONTAL

Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Ingersoll Milling Mch. Co., Rockford, Ill.
Landis Tool Co., Waynesboro, Pa.
Lucas Mch. Tool Co., Cleveland.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Pedrick Tool & Mch. Co., 3639 No. Lawrence St., Philadelphia.
Rockford Drilling Machine Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia.
Sommer & Adams Co., Cleveland.

BORING HEADS, OFFSET

Production Engineering Corp., Canastota, N. Y.
Waterston, J. M., 425 Woodward Ave., Detroit.

BORING TOOLS

American Hollow Boring Co., Erie, Pa.
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Lovejoy Tool Co., Inc., Springfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Ready Tool Co., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

BOXES, CARBONIZING

Farrell-Cheek Steel Fdry. Co., Sandusky, O.

BRAKES, BENDING

Loy & Nawrath Div., Birmingham Iron Foundry, Derby, Conn.

BRAZING EQUIPMENT

American Gas Furnace Co., Elizabeth, N. J.

BROACHES

American Broach & Machine Co., Ann Arbor, Mich.
Lapointe Co., J. N., New London, Conn.
Lapointe Mch. Tool Co., Hudson, Mass.
Oilgear Co., Milwaukee, Wis.

BROACH GRINDING MACHINES

Lapointe Co., J. N., New London, Ct.

BROACHING MACHINES

American Broach & Machine Co., Ann Arbor, Mich.
Lapointe Co., J. N., New London, Ct.
Lapointe Machine Tool Co., Hudson, Mass.
Oilgear Co., Milwaukee, Wis.
Toledo Mch. & Tool Co., Toledo.
V & O Press Co., Hudson, N. Y.

BROACHING PRESS, HAND

American Broach & Machine Co., Ann Arbor, Mich.

BRONZE

Ajax Metal Co., Philadelphia, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio.

BUFFERS

Blount, J. G., Co., Central Ave., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Builders Iron Foundry, Providence, R. I.
Cleveland Armature Works, Cleveland.
Divine Bros. Co., Utica, N. Y.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.
Marschke Mfg. Co., Indianapolis, Ind.
Mitchell Engineering Co., Springfield, Ohio.
Neil & Smith Electric Tool Co., Cincinnati.
Stow Mfg. Co., Binghamton, N. Y.

BUFFING MACHINES, AUTOMATIC

Automatic Buffing Mch. Co., Buffalo, N. Y.

BULLDOZERS

Ajax Mfg. Co., Cleveland.
Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.
Williams, White & Co., Moline, Ill.

BURNERS, GAS AND OIL

Surface Combustion Co., 363 Gerard Ave., New York.

BURNISHING MACHINERY

Abbott Ball Co., Elmwood, Hartford, Conn.
Baird Machine Co., Bridgeport, Conn.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.

BURRING MACHINES, FORGING

Ajax Mfg. Co., Cleveland, O.

BUSHINGS, BRASS, BRONZE, ETC.

Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Bunting Brass & Bronze Co., Toledo, Ohio.
Wilmington Fibre Specialty Co., Wilmington, Del.

BUSHINGS, HARDENED

Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.

CABINETS, FILING

Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Economy Drawing Table Mfg. Co., Adrian, Mich.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Machine Co., Rochester, N. Y.

CABINETS, TOOL

Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Gerstner & Sons, H., Dayton, O.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

CALCIUM CARBIDE

Air Reduction Sales Co., 342 Madison Ave., New York.

CALIPER GAGES

Williams, J. H., & Co., Buffalo, N. Y.

CALIPERS

Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

CAMS

Garvin Machine Co., Spring and Varick Sts., New York.
Rowbottom Mch. Co., Waterbury, Ct.

CASE-HARDENING

American Gas Furnace Co., Elizabeth, N. J.
Meisel Press Mfg. Co., 948 Dorchester, Ave., Boston 25, Mass.
Williams, J. H., & Co., Buffalo, N. Y.

CASE-HARDENING COMPOUND

Kasenit Co., Div. 3, 2 Stone St., New York.

CASE-HARDENING FURNACES

See furnaces, Case-hardening.

CASTINGS, BRASS, BRONZE AND ALUMINUM

Ajax Metal Co., Philadelphia.
Bunting Brass & Bronze Co., Toledo.

CASTINGS, DIE OR DIE MOLDED

Alemite Die-Casting Mfg. Co., 2640-54 Belmont Ave., Chicago.
Doehler Die-Casting Co., Brooklyn, N. Y.
Franklin Die-Casting Corp., Syracuse, N. Y.
Hoyt Metal Co., St. Louis, Mo.
McGill Metal Co., Valparaiso, Ind.
Mt. Vernon Die-Casting Corp., Mt. Vernon, N. Y.
Phoenix Die Casting Co., Buffalo.
Republic Die Casting Co., Inc., 128E Mott St., New York.
Soss Mfg. Co., Brooklyn, N. Y.
Sterling Die Casting Co., Inc., Brooklyn, N. Y.
Superior Die-Casting Co., Cleveland,
Veeder Mfg. Co., 39 Sergeant St.,

CASTINGS, DIE OR DIE MOLDED ALUMINUM

Alemite Die-Casting & Mfg. Co., 2640-54 Belmont Ave., Chicago.
Doehler Die-Casting Co., Brooklyn, N. Y.
Franklin Die-Casting Corp., Syracuse, N. Y.
Mt. Vernon Die-Casting Corp., Mt. Vernon, N. Y.
Republic Die Casting Co., Inc., 128E Mott St., New York.
Soss Mfg. Co., Brooklyn, N. Y.
Sterling Die Casting Co., Inc., Brooklyn, N. Y.
Superior Die-Casting Co., Cleveland.

CASTINGS, GRAY IRON

Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engineering Co., Chambersburg, Pa.
Cresson-Morris, Philadelphia.
Reed-Prentice Co., Worcester, Mass.
Sweet & Doyle Fdry. & Mch. Co., Troy, Green Island, N. Y.
Toledo Mch. & Tool Co., Toledo, O.

CASTINGS, MALLEABLE

Link-Belt Company, Chicago.

CASTINGS, STEEL

Cresson-Morris Co., Philadelphia.
Farrell-Cheek Steel Foundry Co., Sandusky, O.

CEMENT, DISC GRINDING WHEEL

Badger Tool Co., Beloit, Wis.
Besly & Co., Chas. H., 120-B N. Clinton St., Chicago.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.

CENTERING MACHINES

Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Hanson-Whitney Machine Co., Hartford, Conn.
Hendey Mch. Co., Torrington, Conn.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Pratt & Whitney, Hartford, Conn.
Whiton Mach. Co., D. E., New London, Conn.

CENTERS, PLANER AND MILLER

Cincinnati Planer Co., Cincinnati.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

CHAIN BLOCKS

See Hoists, Chain, etc.

CHAINS, POWER TRANSMISSION

Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Duckworth Chain & Mfg. Co., Springfield, Mass.
Link-Belt Company, Chicago.
Morse Chain Co., Ithaca, N. Y.
Ramsey Chain Co., Inc., Albany, N. Y.
Whitney Mfg. Co., Hartford, Conn.

CHECKS, TIME, TOOL AND PAY

Noble & Westbrook Mfg. Co., Hartford, Conn.
Schwerdtle Stamp Co., Bridgeport, Ct.

CHIP CRUSHER

American Crusher & Mchry. Co., 1 Madison Ave., New York.

CHISEL BLANKS, PNEUMATIC HAMMER

Hunter Saw & Mch. Co., Pittsburgh.
Ingersoll-Rand Co., 11 Broadway, New York.

CHISELS, PNEUMATIC HAMMER

Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.

CHUCKING MACHINES AUTOMATIC

Baird Machine Co., Bridgeport, Conn.
Bullard Machine Tool Co., Bridgeport, Conn.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Goss & DeLeeuw Machine Co., New Britain, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Machine Co., Pawtucket, R. I.

CHUCKING MACHINES, SEMI-AUTOMATIC

Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
National Acme Co., Cleveland, O.

CHUCKS, AIR-OPERATED

Bardons & Oliver, Cleveland.
Frontier Chuck & Tool Co., Buffalo, N. Y.
Garvin Machine Co., Spring and Varick Sts., New York.
Logansport Machine Co., 529 Market St., Logansport, Ind.

CHUCKS, COLLET OR SPLIT

Ames Co., B. C., Waltham, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Stark Tool Co., Waltham, Mass.
Wade-American Tool Co., Waltham, Mass.
Whitney Mfg. Co., Hartford, Conn.

CHUCKS, DRILL

Almond Mfg. Co., T. R., Ashburnham, Mass.
Boker, H., & Co., Inc., 103 Duane St., New York.
Cleveland Twist Drill Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Cushman Chuck Co., Hartford, Conn.
Detroit Twist Drill Co., Detroit.
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.
Jacobs Mfg. Co., Hartford, Conn.
McCrosky Tool Corp., Meadville, Pa.
Modern Tool Co., Erie, Pa.
Modern Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Production Engineering Corp., Canastota, N. Y.
Scully-Jones Co., 13th and Robey Sts., Chicago.
Standard Tool Co., Cleveland.
Union Mfg. Co., New Britain, Conn.
Waterston, J. M., 425 Woodward Ave., Detroit.
Watts Bros. Tool Works, Turtle Creek, Pa.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

CHUCKS, ECCENTRIC BORING

Production Engineering Corp., Canastota, N. Y.

CHUCKS, FULL FLOATING

Errington Mechanical Laboratory, Broadway and John St., New York.
Watts Bros. Tool Wks., Turtle Creek, Pa.

CHUCKS, LATHE, ETC.

Almond Mfg. Co., T. R., Ashburnham, Mass.
Bullard Machine Tool Co., Bridgeport, Conn.
Cushman Chuck Co., Hartford, Conn.
Foster Machine Co., Elkhart, Ind.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
McCrosky Tool Corp., Meadville, Pa.
Rivett Lathe & Grinder Corp., Brighton District, Boston.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Terkelsen Machine Co., Boston.
Thomas Elevator Co., 24 So. Hoyne Ave., Chicago.
Union Mfg. Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mch. Co., D. E., New London, Conn.

CHUCKS, MAGNETIC

Heald Mch. Co., 16 New Bond St., Worcester, Mass.
Walker Co., Inc., O. S., Worcester, Mass.

CHUCKS, PLANER

Cincinnati Planer Co., Cincinnati, O.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Union Mfg. Co., New Britain, Conn.

CHUCKS, QUICK CHANGE AND SAFETY

Errington Mechanical Laboratory, Broadway and John St., New York.
Geometric Tool Co., New Haven, Ct.
McCrosky Tool Corp., Meadville, Pa.
National Tool Co., Cleveland.
Whitney Mfg. Co., Hartford, Conn.

CHUCKS, RING WHEEL

Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, TAPPING

Barber-Colman Co., Rockford, Ill.
Errington Mechanical Laboratory, Broadway and John St., New York.
McCrosky Tool Corp., Meadville, Pa.
Procunier, Wm. L., 18 South Clinton St., Chicago.
Scully-Jones & Co., 13th and Robey Sts., Chicago.
Watts Bros. Tool Wks., Turtle Creek, Pa.
Whitney Mfg. Co., Hartford, Conn.

CHUCKS, VACUUM

Chicago Pneumatic Tool Co., 6 E. 44th St., New York.

CIRCUIT BREAKERS

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

CLAMPS

Armstrong Bros. Tool Co., 313 No. Francisco Ave., Chicago.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Brown & Sharpe Mfg. Co., Providence, R. I.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

BUNTING
BUSHING BEARINGS
PATENTED

"They're Always in Stock" in Seven Cities

THE Bunting Brass & Bronze Company is a local institution in the seven principal industrial centers of America. In Toledo, New York, Boston, Philadelphia, Cleveland, Chicago, San Francisco, you'll find great stocks of the 269 "Ready Made" BUNTING BUSHING BEARINGS; counsel, quotations, personal service on special sizes, designs or alloys; ample stocks of Piston Pin Bushings and Spring Bolt Bushings for automotive replacement; and Cored and Solid Bars of BUNTING Phosphor Bronze for shop use.

MANUFACTURERS

If you are not already benefiting by BUNTING "Ready Made" BUSHING BEARINGS phone or write for Stock List G.

SPECIAL SIZES

BUNTING experience and plant efficiency will increase the satisfaction and economy of using bearings of your own design. Let us figure with you.

MILL SUPPLY JOBBERS

A stock of BUNTING Cored and Solid Bronze Bars will bring you new volume and profit. Hundreds of stock sizes, and a conveniently boxed Shop Assortment. Write for Stock List 201.

THE BUNTING BRASS & BRONZE COMPANY

Main Office and Factory

TOLEDO - OHIO

Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.
Starrett Co., L. S., Athol, Mass.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

CLEANSERS, CHEMICAL, FOR WASTE AND METAL
International Chemical Co., Philadelphia.
Oakley Chemical Co., 26 Thames St., New York.

CLEANING COMPOUND
See Compound, Cleaning.

CLOCKS, WATCHMEN'S
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.

CLUTCHES, FRICTION, ETC.
Brown Co., A. & F., 79 Barclay St., New York.
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Conway Clutch Co., Cincinnati, O.
Cresson-Morris Co., Philadelphia.
Edgemont Machine Co., Dayton, O.
Farrel Fdry. & Mch. Co., Inc., Buffalo, N. Y.
Hilliard Clutch & Mchy. Co., Elmira, N. Y.
Johnson Machine Co., Carlyle, Manchester, Conn.
Jones Foundry & Machine Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Link-Belt Co., Chicago.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Production Machine Co., Greenfield, Mass.
Skayef Ball Bearing Co., 165 Broadway, New York.
S K F Industries, Inc., 165 Broadway, New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

CLUTCHES, MAGNETIC
Magnetic Mfg. Co., Milwaukee, Wis.

COLLARS, SAFETY
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown Co., A. & F., 79 Barclay St., New York.
Link-Belt Company, Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

COLLARS, SPACING, ETC.
Detroit Stamping Co., Detroit, Mich.
Scully-Jones Co., 13th and Robey Sts., Chicago.

COLLETS
Cleveland Twist Drill Co., Cleveland.
Geometric Tool Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

COLLETS, SPRING
Ames Co., B. C., Waltham, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Stark Tool Co., Waltham, Mass.
Whitney Mfg. Co., Hartford, Conn.

COMMUTATORS
Cleveland Armature Works, Cleveland.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

COMPARATOR, SCREW THREAD
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Ferner Co., R. Y., Washington, D. C.
Jones & Lamson Mch. Co., Springfield, Vermont.

COMPOUND, CLEANING
International Chemical Co., Philadelphia.
Oakley Chemical Co., 26 Thames St., New York.

COMPOUND, CUTTING, GRINDING, ETC.
International Chemical Co., Philadelphia.
Oakley Chemical Co., 26 Thames St., New York.
Sun Oil Company, Philadelphia.

COMPRESSORS, AIR AND GAS
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York.

CONDUITS
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.

CONNECTORS, FRANKEL, SOLDERLESS
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

CONTRACT WORK
Adamson Mch. Co., Akron, O.
American Tool & Mfg. Co., Urbana, O.
Banner Die, Tool & Stamping Co., Columbus, O.
Bliss Co., E. W., Brooklyn, N. Y.
Brock Tool & Mfg. Works, Arthur, Jr., Philadelphia.
Brown & Sharpe Mfg. Co., Providence, R. I.
Columbus Die, Tool & Mch. Co., Columbus, O.
Davenport Mfg. Co., Meadville, Pa.
Diefendorf Gear Corp., Syracuse, N. Y.
DuPont Engineering Co., Wilmington, Del.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Globe Machine & Stamping Co., 1255 W. 76th St., Cleveland, O.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Kent-Owens Mch. Co., Toledo, O.
Kremer-Cummins Mch. Co., Cleveland.
Langelier Mfg. Co., Arlington, Cranston, R. I.
LeBlond, R. K., Machine Tool Co., Cincinnati.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, 25.
Minster Machine Co., Minster, O.
Mummert-Dixon Co., Hanover, Pa.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Orrell, R. W., Mch. Co., Flint, Mich.
Paxson Co., J. W., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Production Engineering Corp., Canastota, N. Y.
Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
Smalley-General Co., Inc., Bay City, Mich.
Steel Products Engineering Co., Springfield, O.
Sweet & Doyle Fdry. & Mch. Co., Troy, Green Island, N. Y.
Taylor & Fenn Co., Hartford, Conn.
Taylor-Shantz Co., Rochester, N. Y.
U. S. Tool Co., Inc., Newark, N. J.
V & O Press Co., Hudson, N. Y.
Wicaco Screw & Mch. Works, Inc., Philadelphia.
Woods Engineering Co., Alliance, O.

CONTROLLERS
American Gas Furnace Co., Elizabeth, N. J.
General Electric Co., Schenectady, N. Y.
Monitor Controller Co., Baltimore, Md.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

CONVEYORS, BELT
Link-Belt Company, Chicago.

CONVEYORS, GRAVITY
Link-Belt Company, Chicago.

COTTER PINS
Williams, J. H., & Co., Buffalo, N. Y.

COUNTERBORES
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Gairing Tool Co., Detroit.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Starrett Co., L. S., Athol, Mass.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

COUNTERSHAFTS, FRICTION, ETC.
Bardons & Oliver, Cleveland.
Brown Co., A. & F., 79 Barclay St., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Fdry., Providence, R. I.
Diamond Mch. Co., Providence, R. I.
Edgemont Mch. Co., Dayton, O.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Hilliard Clutch & Machinery Co., Elmira, N. Y.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Warner & Swasey Co., Cleveland.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUNTERSINKS
Cogsdill Mfg. Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Whitman & Barnes Mfg. Co., Akron, O.

COUNTERS, REVOLUTION
Bristol Co., Waterbury, Conn.
Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn.
Root Co., Bristol, Conn.
Starrett Co., L. S., Athol, Mass.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

COUPLERS, HOSE
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Greene, Tweed & Co., 109 Duane St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.

COUPLINGS, CUT-OFF, FRICTION
Conway Clutch Co., Cincinnati, O.
Edgemont Machine Co., Dayton, O.
Johnson Machine Co., Carlyle, Manchester, Conn.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUPLINGS, FLEXIBLE SHAFT
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.
Cresson-Morris Co., Philadelphia.
Foote Bros. Gear & Mch. Co., 232 N. Curtis St., Chicago.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Nuttall Co., R. D., Pittsburgh.
Smith & Serrell, Newark, N. J.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUPLINGS, PIPE
Dart Mfg. Co., E. M., Providence, R. I.

COUPLINGS, SHAFT
Adamson Mch. Co., Akron, O.
Brown Co., A. & F., 79 Barclay St., New York.
Brown Engineering Co., 133 N. Third St., Reading, Pa.
Cresson-Morris Co., Philadelphia.
Foote Bros. Gear & Mch. Co., 232 N. Curtis St., Chicago.
Hilliard Clutch & Mchy. Co., Elmira, N. Y.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Sellers & Co., Inc., Wm., Philadelphia.
Smith & Serrell, Newark, N. J.
Wood's Sons Co., T. B., Chambersburg, Pa.

CRANES
Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Harrington Co., Philadelphia.
Harris Engineering Co., Bridgeport, Ct.
Link-Belt Company, Chicago.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Vandyck-Churchill Co., 149 Broadway, New York.
Whiting Corp., Harvey, Ill.

CRANES, ELECTRIC TRAVELING
Link-Belt Company, Chicago.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Roeper Crane & Hoist Works, Reading, Pa.
Whiting Corp., Harvey, Ill.

CRANES, HAND TRAVELING
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Roeper Crane & Hoist Works, Reading, Pa.
Whiting Corp., Harvey, Ill.

CRANES, LOCOMOTIVE
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Link-Belt Company, Chicago.
Pawling & Harnischfeger Co., Milwaukee, Wis.

CRANES, PORTABLE
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Canton Fdry. & Mch. Co., Canton, O.
Elwell-Parker Electric Co., Cleveland.
Pawling & Harnischfeger Co., Milwaukee, Wis.

CRANK PIN TURNING MACHINES
American Tool Works Co., Cincinnati.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

CRUCIBLES
Dixon Crucible Co., Joseph, Jersey City, N. J.

CUTTER COMPOUND
See Compound, Cutting, Grinding, etc.

CUTTERS, MILLING
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clark Cutter Co., Detroit, Mich.
Cleveland Twist Drill Co., Cleveland.
Columbus Die, Tool & Mch. Co., Columbus, O.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Cowles Tool Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Gammons-Holman Co., Manchester, Conn.
Goddard & Goddard Co., Detroit.
Gould & Eberhardt, Newark, N. J.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Lovejoy Tool Co., Inc., Springfield, Vermont.
Modern Tool Wks., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Newark Gear Cutting Machine Co., Newark, N. J.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney, Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Sommer & Adams Co., Cleveland.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Conn.

CUTTING-METALS OR ALLOYS
Haynes Stellite Co., 30 E. 42nd St., New York.

CUTTING-OFF MACHINES, ABRASIVE WHEEL
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Greenfield Tap & Die Corp., Greenfield, Mass.

CUTTING-OFF MACHINES, COLD SAW
See Sawing Machines, Circular.

CUTTING-OFF MACHINES, ROTARY
Brown & Sharpe Mfg. Co., Providence, R. I.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Etna Machine Co., Toledo, O.
Fawcus Machine Co., Pittsburgh, Pa.
Hurlbut, Rogers Mchy. Co., Nashua, N. H.

CUTTING-OFF TOOLS
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Ready Tool Co., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

CYCLOMETERS
Veeder Mfg. Co., 39 Sergeant St., Hartford, Conn.

CYLINDER BORING MACHINES
Baker Bros., Inc., Toledo, O.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Ingersoll Milling Mch. Co., Rockford, Ill.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

CYLINDER BORING MACHINES, PORTABLE
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia, Pa.

DEALERS, MACHINERY
Allen, H. F., Co., Inc., 30 Church St., New York.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia.
East Dayton Mfg. Co., Dayton, Ohio.
Essley Machinery Co., E. L., 551-57 W. Washington Blvd., Chicago.
Harris, Samuel, & Co., 114-116 N. Clinton St., Chicago.
Hill, Clarke & Co., Inc., Boston.
Jones Mch. Tool Co., Cincinnati.
Kinsey Co., E. A., Cincinnati.
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Lynd-Farquhar Co., Boston.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osgood Tool Co., J. L., Buffalo, N. Y.
Oviatt, D. C., & Co., Cleveland.
Prentiss & Co., Inc., Henry, 149 Broadway, New York.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Vandyck Churchill Co., 149 Broadway, New York.

DEMAGNETIZERS
Heald Machine Co., 16 New Bond St., Worcester, Mass.
Littlejohn, A. J., Syracuse, N. Y.
Luma Electric Equipment Co., Toledo, Ohio.
Walker Co., Inc., O. S., Worcester, Mass.

DESIGNERS, MACHINE AND TOOL
Manufacturers Consulting Engineers, Syracuse, N. Y.

DIAMONDS, BORTZ AND CARBON
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.
Wheel Trueing Tool Co., Detroit.

DIAMOND TOOLS
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.
Wheel Trueing Tool Co., Detroit.

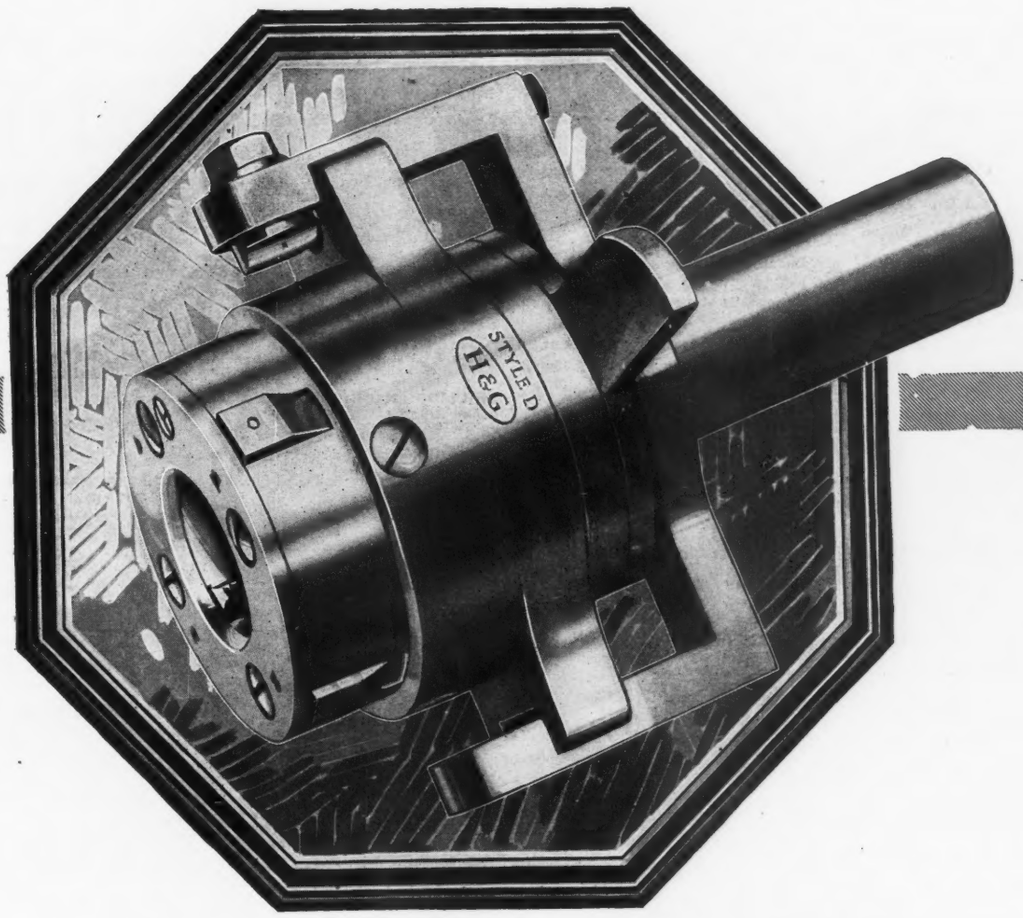
DIE BLOCKS
Dyson & Sons, Joseph, Cleveland, O.

DIE CASTINGS
See Castings, Die or Die Molded.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

Do You Operate Brown & Sharpe Automatics?

If so, you will be vitally interested in the new business-like H & G Die Head Style D with double drive



H & G Style "D" DIE HEADS

Made in 1/4" size for No. 00, No. 00-G and No. 19 machines.

Made in 7/16" size for No. 0 and No. 0-G machines.

Made in 9/16" size for No. 2 and No. 2-G machines.

It would delight any mechanic's eye to see battery after battery of B & S Automatics with their H & G Die Heads bobbing up like a sea of porpoises with every revolution of the turret, each one cutting a perfect thread as fast as the machines can be driven.

H & G die heads materially enlarge the production possibilities of these automatics and have the following advantages:

1. No reversal of spindle is necessary.
2. The machine is seldom shut down for die troubles.
3. High speed chasers permit high speed.
4. Reversed belt, instead of being used to back off die, may provide an additional forward cutting thread.
5. Simplifies cam design since it merely starts the die.
6. Improves the quality and appearance of the thread.
7. Will cut threads of accurate length.
8. Chasers will outlast from ten to twenty button dies.
9. Micrometer adjustment for accurate pitch diameters.
10. Most important of all: It is an H & G.

The double drive feature, illustrated above, eliminates any possibility of cramping and assures smooth action.

Any of the above heads will be gladly shipped to responsible concerns subject to a thirty day trial.

Send for catalog. H & G Die Heads are available in styles and sizes for all machines on which threads are cut.

THE EASTERN MACHINE SCREW CORPORATION

23-43 Barclay St., New Haven, Conn.

Canadian Representative: Arthur Jackson, 177 Roxborough St., East, Toronto, Ontario

STANDARDIZE ON H&G DIE HEADS

DIE CUSHIONS, PNEUMATIC
Marquette Tool & Mfg. Co., 321 West Ohio St., Chicago.

DIE MAKERS' SUPPLIES
Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.
U. S. Tool Co., Inc., Newark, N. J.

DIE SETS, STANDARD
Danly Machine Specialties, 4907 Lincoln Ave., Chicago.
Diamant Tool & Mfg. Co., Inc., Newark, N. J.
U. S. Tool Co., Inc., Newark, N. J.

DIE SINKERS, AUTOMATIC
Keller Mechanical Engineering Corp., 74 Washington St., Brooklyn, N. Y.

DIE SINKING MACHINES
Pratt & Whitney, Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.

DIE STOCKS
See Stocks, Die and Taps and Dies.

DIE, DROP FORGING
Keller Mechanical Engineering Corp., 74 Washington St., Brooklyn, N. Y.

DIES, DRAWING, PRESSURE ATTACHMENTS
King, R. D., 1620 Monadnock Block, Chicago.
Marquette Tool & Mfg. Co., 321 West Ohio St., Chicago.

DIES, LETTERING AND EMBOSSING
Noble & Westbrook Mfg. Co., Hartford, Conn.
Schoder & Lombard Stamp Co., 202 Centre St., New York.
Schwerdtle Stamp Co., Bridgeport, Conn.

DIES, SHEET METAL, ETC.
Adriance Machine Works, Inc., 78 Richards St., Brooklyn, N. Y.
American Tool & Mfg. Co., Urbana, O.
Ams, Max, Machine Co., 101 Park Ave., New York.
Banner Die, Tool & Stamping Co., Columbus, O.
Bliss Co., E. W., Brooklyn, N. Y.
Columbus Die, Tool & Machine Co., Columbus, O.
Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.
Davenport Mfg. Co., Meadville, Pa.
Diamant Tool & Mfg. Co., Inc., Newark, N. J.
Ferracute Mch. Co., Bridgeton, N. J.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.
Keller Mechanical Engineering Corp., 74 Washington St., Brooklyn, N. Y.
King, R. D., 1620 Monadnock Block, Chicago.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Orrell, R. W., Mch. Co., Flint, Mich.
Production Engineering Corp., Canastota, N. Y.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Taylor Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
U. S. Tool Co., Newark, N. J.
V & O Press Co., Hudson, N. Y.
Wade-American Tool Co., Waltham, Mass.
Waltham Machine Works, Waltham, Mass.

DIES, THREADING
Brubaker & Bros., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Div. Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Geometric Tool Co., New Haven, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Bros. Inc., Berteau and Ravenswood Aves., Chicago.
Jones & Lamson Mch. Co., Springfield, field, Vt.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland, O.
Pratt & Whitney, Hartford, Conn.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, Inc., D., Yonkers, N. Y.
Standard Tool Co., Cleveland.

DIES, THREADING, OPENING
Butterfield & Co., Div., Union Twist Drill Co., Derby Line, Vt.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Eastern Machine Screw Corp., New Haven, Conn.
Errington Mechanical Laboratory, Broadway and John St., New York.
Geometric Tool Co., New Haven, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
H & G Works, Eastern Mch. Screw Corp., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co., Inc., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Mch. & Tool Co., 34 Porter St., Detroit.
National Acme Co., Cleveland, O.

DIES, THREAD ROLLING
Hanson-Whitney Mch. Co., Hartford, Conn.

DISCS, ABRASIVE
Badger Tool Co., Beloit, Wis.
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

DIVIDING HEADS
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Knight Mchy. Co., W. B., St. Louis.
LeBlond, R. K., Machine Tool Co., Cincinnati.
See also Milling Machines, Horizontal, Universal.

DOWEL PINS
Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.

DRAFTING INSTRUMENTS
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Mch. Co., Rochester, N. Y.

DRAFTING MACHINES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Universal Drafting Mch. Co., Cleveland, Ohio.

DRAWING BOARDS AND TABLES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Economy Drawing Table & Mfg. Co., Adrian, Mich.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Mch. Co., Rochester, N. Y.
Universal Drafting Mch. Co., Cleveland, O.

DRAWING MATERIALS
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Paragon Mch. Co., Rochester, N. Y.

DRESSERS, GRINDING WHEEL
Abrasive Co., Bridesburg, Philadelphia.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Calder Co., George H., Lancaster, Pa.
Cleveland Stone Co., Cleveland.
Desmond-Stephan Mfg. Co., Urbana, Ohio.
Francis & Co., Hartford, Conn.
Hetherington Co., Piqua, O.
Norton Co., Worcester, Mass.
Reed Mfg. Co., Erie, Pa.
Standard Tool Co., Cleveland, O.
Western Tool & Mfg. Co., Springfield, Ohio.

DRIFTS, DRILL
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Whitman & Barnes Mfg. Co., Akron, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

DRILL HEADS, MULTIPLE
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Errington Mechanical Laboratory, Broadway and John St., New York.
Hoefer Mfg. Co., Freeport, Ill.
National Automatic Tool Co., Richmond, Ind.
Rockford Drilling Machine Co., Rockford, Ill.
United States Drill Head Co., 1948-1956 W. 6th St., Cincinnati.

DRILL RODS, CARBON AND HIGH SPEED
Anchor Drawn Steel Co., Latrobe, Pa.

DRILL SOCKETS
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Scully-Jones & Co., 13th and Robey Sts., Chicago.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

DRILL SPEEDERS
Graham Mfg. Co., Providence, R. I.

DRILL STANDS
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland.
Waterson, J. M., 25 Woodward Ave., Detroit.
Whitman & Barnes Mfg. Co., Akron, Ohio.

DRILLING AND MILLING MACHINES, VERTICAL
Knight Mchy. Co., W. B., St. Louis.
Moline Tool Co., Moline, Ill.
Taylor & Fenn Co., Hartford, Conn.

DRILLING MACHINES, AUTOMATIC
Baker Bros., Inc., Toledo, Ohio.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.

DRILLING MACHINES, BENCH
Ames Co., B. C., Waltham, Mass.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Burke Machine Tool Co., 516 Sandusky St., Conneaut, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
High Speed Hammer Co., Inc., Rochester, N. Y.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
LeBlond, R. K., Machine Tool Co., Cincinnati.
Leland Gifford Co., Worcester, Mass.
National Automatic Tool Co., Richmond, Ind.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Rockford Drilling Machine Co., Rockford, Ill.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
Wisconsin Electric Co., Racine, Wis.

DRILLING MACHINES, BOILER
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Foote-Burt Co., Cleveland.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

DRILLING MACHINES, GANG
Baker Bros., Inc., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Colburn Machine Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Foote-Burt Co., Cleveland.
Fosdick Mch. Tool Co., Cincinnati.
Garvin Machine Co., Spring and Varick Sts., New York.
Hoefer Mfg. Co., Freeport, Ill.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kingsbury Mfg. Co., Keene, N. H.
Leland-Gifford Co., Worcester, Mass.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Rockford Drilling Mch. Co., Rockford, Ill.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
Taylor & Fenn, Hartford, Conn.

DRILLING MACHINES, HEAVY DUTY
Avey Drilling Mch. Co., Cincinnati.
Baker Bros., Inc., Toledo, Ohio.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Colburn Machine Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Foote-Burt Co., Cleveland.
Ingersoll Milling Mch. Co., Rockford, Ill.
Minster Mch. Co., Minster, O.
Rockford Mch. Tool Co., Rockford, Ill.

DRILLING MACHINES, HORIZONTAL, DUPLEX
Garvin Mch. Co., Spring and Varick Sts., New York.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.

DRILLING MACHINES, MULTIPLE SPINDLE, ADJUSTABLE
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Foote-Burt Co., Cleveland.
Harrington Co., Philadelphia.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
Pratt & Whitney Co., Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.
United States Drill Head Co., Cincinnati, O.

DRILLING MACHINES, MULTIPLE SPINDLE, HORIZONTAL
Baush Machine Tool Co., Springfield, Mass.
Harrington Co., Philadelphia.
Ingersoll Milling Mch. Co., Rockford, Ill.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
National Acme Co., Cleveland.
National Automatic Tool Co., Richmond, Ind.
United States Drill Head Co., 1948-1956 W. 6th St., Cincinnati, O.

DRILLING MACHINES, MULTIPLE SPINDLE, TURRET
Langelier Mfg. Co., Arlington, Cranston, R. I.

DRILLING MACHINES, MULTIPLE SPINDLE, VERTICAL
Avey Drilling Mch. Co., Cincinnati.
Baker Bros., Inc., Toledo, Ohio.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Colburn Machine Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Foote-Burt Co., Cleveland.
Harrington Co., Philadelphia.
Hoefer Mfg. Co., Freeport, Ill.
Ingersoll Milling Mch. Co., Rockford, Ill.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney, Hartford, Conn.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Rockford Drilling Mch. Co., Rockford, Ill.
Rockford Machine Tool Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia.
Sipp Machine Co., Paterson, N. J.
United States Drill Head Co., 1948-1956 W. 6th St., Cincinnati, O.

DRILLING MACHINES, PNEUMATIC
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.

DRILLING MACHINES, PORTABLE ELECTRIC
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Errington Mechanical Laboratory, Broadway and John Sts., New York.
Haskins Co., R. G., 518½ W. Monroe St., Chicago.
Neil & Smith Electric Tool Co., Cincinnati.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tool Co., Cleveland.
Wisconsin Electric Co., Racine, Wis.

DRILLING MACHINES, RADIAL
American Tool Works Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Dreses Machine Tool Co., Cincinnati.
Fosdick Machine Tool Co., Cincinnati.
Morris Machine Tool Co., Cincinnati.
Mueller Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Co., Worcester, Mass.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Sellers & Co., Inc., Wm., Philadelphia.
Western Mch. Tool Works, Holland, Mich.
Wickes Bros., Saginaw, Mich.

DRILLING MACHINES, RAIL
Baker Bros., Inc., Toledo, Ohio.
Colburn Machine Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Foote-Burt Co., Cleveland.
General Electric Co., Schenectady, N. Y.
Harrington Co., Philadelphia.
Moline Tool Co., Moline, Ill.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

DRILLING MACHINES, SENSITIVE
Avey Drilling Mch. Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Burke Machine Tool Co., 516 Sandusky St., Conneaut, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Fosdick Mch. Tool Co., Cincinnati.
High Speed Hammer Co., Inc., Rochester, N. Y.
Kingsbury Mfg. Co., Keene, N. H.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Manufacturers Consulting Engineers, Syracuse, N. Y.
Muehlmatt, Adolph, Cincinnati.
Pratt & Whitney, Hartford, Conn.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Rockford Machine Tool Co., Rockford, Ill.
Sibley Machine Co., 8 Tutt St., South Bend, Ind.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
Sipp Machine Co., Paterson, N. J.
Townsend, H. P., Mfg. Co., Hartford, Conn.
United States Machine Tool Co., Cincinnati.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

The Upright Drills

with that Great Range of Automatic Feed for your Boring and Reaming Job

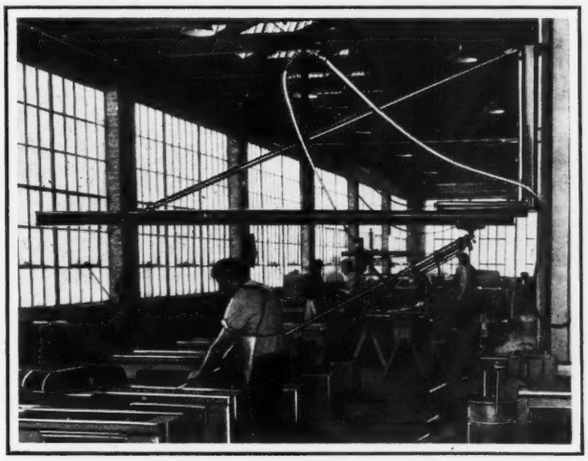
REQUIRING

Accuracy
Speed
Production

We build all sizes from 20" to 46"

J. E. SNYDER & SON CO.
Worcester, Mass., U. S. A.

The Time and Money-Saving Way



Anderson Pneumatic Scraper

Wherever Anderson Pneumatic Scraping takes the place of hand scraping, one man does the work of three, with the same accuracy and without losing the important "human touch" of hand scraping.

A new model Anderson is now available. It is the "Jib Type" which permits the operator to scrape work within a radius of 18 feet. The universal swing of the scraper arm, combined with the 160° swing of the jib arm, allows the operator to cross-scrape without moving the work—no turn-table necessary for heavy castings.

"Do it with air" and pull down scraping costs!
Full information on request.

ANDERSON BROS. MFG. CO.
1910 KISHWAUKEE ST., ROCKFORD, ILL.

New Catalogue of Cold-Drawn

HOLLOW SCREWS

—awaiting word from all of our customers, as to where and how many to send.

The book catalogues not only the product, but points of interest on the manufacture and *use* both of hollow set screws and socket head cap screws.

It carries convenient charts of the styles, sizes and prices of the cold-drawn screws—besides the Allen *wrenches* with the cold-drawn sockets.

To you who are users of Allen products, the book has a well-known value for economies it helps put in practice. And to you who say, "We're not using ALLENS but we'll *consider* them," the book will be sent with very many thanks for your consideration.

The Allen Mfg. Co.

125 Sheldon St., Hartford, Conn.

Pacific Coast Branch Office: The Chas. A. Dowd Sales Co., 320 Market Street, San Francisco, Cal.

DRILLING MACHINES, UPRIGHT
Avey Drilling Mch. Co., Cincinnati.
Baker Bros., Inc., Toledo, Ohio.
Barnes, W. F. & John Co., 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Cincinnati-Bickford Tool Co., Oakley, Cincinnati.
Colburn Machine Tool Co., Cleveland.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Foote-Burt Co., Cleveland.
Fosdick Machine Tool Co., Cincinnati.
Garvin Machine Tool Co., Spring and Varick Sts., New York.
Harrington Co., Philadelphia.
Hoefer Mfg. Co., Freeport, Ill.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Leland-Gifford Co., Worcester, Mass.
Minster Machine Co., Minster, O.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed, Francis, Co., 43 Hammond St., Worcester, Mass.
Rockford Drilling Machine Co., Rockford, Ill.
Sellers, Wm., & Co., Inc., Philadelphia.
Sibley Machine Co., 8 Tutt St., South Bend, Ind.
Sigourney Tool Co., 11 Sigourney St., Hartford, Conn.
Sipp Machine Co., Paterson, N. J.
Snyder, J. E., & Son Co., Worcester, Mass.
United States Machine Tool Co., Cincinnati, O.

DRILLING MACHINES, WALL RADIAL
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Pawling & Harnischfeger Co., Milwaukee, Wis.

DRILLS, CENTER
Cleveland Twist Drill Co., Cleveland.
Cogsdill Mfg. Co., Detroit.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney, Hartford, Conn.
Slocomb, J. T., Co., Providence, R. I.
Standard Tool Co., Cleveland.
Whitman & Barnes Mfg. Co., Akron, Ohio.

DRILLS, CORE
Gairing Tool Co., Inc., Detroit.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

DRILLS, RATCHET
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Greene, Tweed & Co., 109 Duane St., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney, Hartford, Conn.
Standard Tool Co., Cleveland.
Whitman & Barnes Mfg. Co., Akron, Ohio.

DRILLS, SQUARE AND HEXAGON
Watts Bros. Tool Wks., Turtle Creek, Pa.

DRILLS, TWIST
Cleveland Twist Drill Co., Cleveland.
Colton, Arthur, Co., 2618 Jefferson Ave., Detroit, Mich.
Detroit Twist Drill Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney, Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

DRINKING WATER FOUNTAINS AND SYSTEMS
Century Brass Works, Belleville, Ill.

DRIVE SCREWS, METALLIC
Parker-Kalon Corp., 353 W. 13th St., New York.

DURALUMIN
Baush Machine Tool Co., Springfield, Mass.

DYNAMOS
General Electric Co., Schenectady, N. Y.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELEVATORS
Atlantic Elevator Co., Inc., Philadelphia.
Link-Belt Company, Chicago.

EMERY WHEELS
See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheel.

ENGINEERS, CONSULTING MECHANICAL
King, R. D., 1620 Monadnock Block, Chicago.
Manfacturers Consulting Engineers, Syracuse, N. Y.

ENGINES, OIL AND GAS
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.

ENGINES, STEAM
Buffalo Forge Co., Buffalo, N. Y.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.

ETCHING APPARATUS, ELECTRIC
Luma Electric Equipment Company, Toledo, Ohio.

EXPANDERS, TUBE
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Watson-Stillman Co., 192 Fulton St., New York.

EXPANSION JOINTS
Nuttall Co., R. D., Pittsburgh.

FANS, ELECTRIC
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

FANS, EXHAUST, ELECTRIC VENTILATING
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y.
Marathon Electric Mfg. Co., Wausau, Wis.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

FERRO TUNGSTEN
Vanadium-Alloys Steel Co., Latrobe, Pa.

FIBRE SPECIALTIES
Wilmington Fibre Specialty Co., Wilmington, Del.

FILE AND TOOL HANDLES
Osgood Tool Co., J. L., Buffalo, N. Y.

FILES
American Swiss File & Tool Co., Elizabeth, N. J.
Delta File Works, Philadelphia.
Nicholson File Co., Providence, R. I.
Simonds Saw & Steel Co., Fitchburg, Mass.

FILES, ROTARY
Strand & Co., N. A., 5001 N. Lincoln St., Chicago.

FILING MACHINES, DIE, ETC.
Ames Co., B. C., Waltham, Mass.
Haskins Co., R. G., 518½ W. Monroe St., Chicago.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, OIL
Tolhurst Machine Works, Troy, N. Y.

FITTINGS, HYDRAULIC
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

FITTINGS, STEAM
Dart, E. M., Mfg. Co., Providence, R. I.

FLUX, WELDING
Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.

FORGES
American Gas Furnace Co., Elizabeth, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.

FORGING MACHINES
Acme Machinery Co., Cleveland.
Ajax Mfg. Co., Cleveland.
Beaudry Co., Inc., Everett, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Williams, White & Co., Moline, Ill.

FORGINGS, DROP
American Forge Co., 2625 S. Hoyne Ave., Chicago.
Bearings Co. of America, Lancaster, Pa.
Champion Machine & Forging Co., Cleveland, O.
Johnston & Jennings Co., Addison Rd., and Lake Shore R. R. Tracks, Cleveland, O.
Williams, J. H., & Co., Buffalo, N. Y.

FORGINGS, IRON AND STEEL
American Forge Co., 2625 S. Hoyne Ave., Chicago.
American Hollow Boring Co., Erie, Pa.
Champion Machine & Forging Co., Cleveland, O.
Dyson & Sons, Joseph, Cleveland.
Johnston & Jennings Co., Addison Rd. and Lake Shore R. R. Tracks, Cleveland, O.
Machinery Forging Co., Cleveland.

FORGINGS, SWAGED, AUTOMOBILE, ETC.
See Swaging, Automobile Parts, etc.

FORMING AND BENDING MACHINES
Air Reduction Sales Co., 342 Madison Ave., New York.
Bethlehem Steel Co., Bethlehem, Pa.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
Niagara Machine & Tool Works, Buffalo, N. Y.
Shuster Co., F. B., New Haven, Conn.

FOUNDRY EQUIPMENT
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., 11 Broadway, New York.
Whiting Corp., Harvey, Ill.

FURNACES, ANNEALING
American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

FURNACES, CASE-HARDENING
American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

FURNACES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Hoskins Mfg. Co., Detroit, Mich.
Leeds & Northrup Co., Philadelphia.
Strong, Carlisle & Hammond Co., Cleveland.

FURNACES, HARDENING
American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., Philadelphia.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

FURNACES, MELTING
American Gas Furnace Co., Elizabeth, N. J.
General Electric Co., Schenectady, N. Y.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.
Whiting Corp., Harvey, Ill.

FURNACES, TEMPERING
American Gas Furnace Co., Elizabeth, N. J.
Brown & Sharpe Mfg. Co., Providence, R. I.
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., Philadelphia.
Strong, Carlisle & Hammond Co., Cleveland.
Surface Combustion Co., 363 Gerard Ave., New York.

FURNITURE, DRAFTING-ROOM
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Economy Drawing Table & Mfg. Co., Adrian, Mich.

FURNITURE, SHOP
New Britain Mch. Co., New Britain, Conn.
Western Tool & Mfg. Co., Springfield, O.

FUSES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

GAGE STANDARDS
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Pratt & Whitney Co., Hartford, Conn.

GAGES, COMPARATOR
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Federal Products Corp., Providence, R. I.
Jones & Lamson Machine Co., Springfield, Vt.

GAGES, DEPTH
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.

GAGES, DIAL
Ames Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Lowe, H. A., Cleveland.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.
Wallace Bros., 160 N. Well St., Chicago.

GAGES, HEIGHT
Brown & Sharpe Mfg. Co., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

GAGES, PLUG AND RING
Brown & Sharpe Mfg. Co., Providence, R. I.
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Ferner Co., R. Y., Washington, D. C.
Greenfield Tap & Die Corp., Greenfield, Mass.
Littlejohn, A. J., Syracuse, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney, Hartford, Conn.

GAGES, RECORDING, STEAM VACUUM
Bristol Co., Waterbury, Conn.
Taylor Instrument Companies, Rochester, N. Y.

GAGES, SNAP
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland.
Ferner Co., R. Y., Washington, D. C.
Greenfield Tap & Die Corp., Greenfield, Mass.
Littlejohn, A. J., Syracuse, N. Y.
Pratt & Whitney, Hartford, Conn.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.
Williams, J. H., & Co., Buffalo, N. Y.

GAGES, SURFACE
Brown & Sharpe Mfg. Co., Providence, R. I.
Columbus Die, Tool & Mch. Co., Columbus, O.
Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.

GAGES, TAPER
Pratt & Whitney, Hartford, Conn.
Starrett Co., L. S., Athol, Mass.

GAGES, THREAD
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Ferner Co., R. Y., Washington, D. C.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson-Whitney Mch. Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
Starrett Co., L. S., Athol, Mass.

GASKETS
Greene, Tweed & Co., 109 Duane St., New York.
Wilmington Fibre Specialty Co., Wilmington, Del.

GEAR BLANKS, BRONZE
Bunting Brass & Bronze Co., Toledo, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

GEAR BLANKS, RAWHIDE
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Ganschow Co., Wm., 16 No. Morgan St., Chicago.
Meachem Gear Corp., Syracuse, N. Y.

GEAR BLANKS, STEEL
American Forge Co., 2625 S. Hoyne Ave., Chicago.
Williams, J. H., & Co., Buffalo, N. Y.

GEAR CUTTING MACHINES, BEVEL (GENERATOR AND TEMPLET PLANER)
Bilgram Machine Works, 1231 Spring Garden St., Philadelphia.
Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, BEVEL (ROTARY CUTTER)
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.
Whiton Mch. Co., D. E., New London, Conn.

GEAR CUTTING MACHINES, HELICAL AND SPUR (HOB)
Adams Co., Dubuque, Iowa.
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Gould & Eberhardt, Newark, N. J.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.

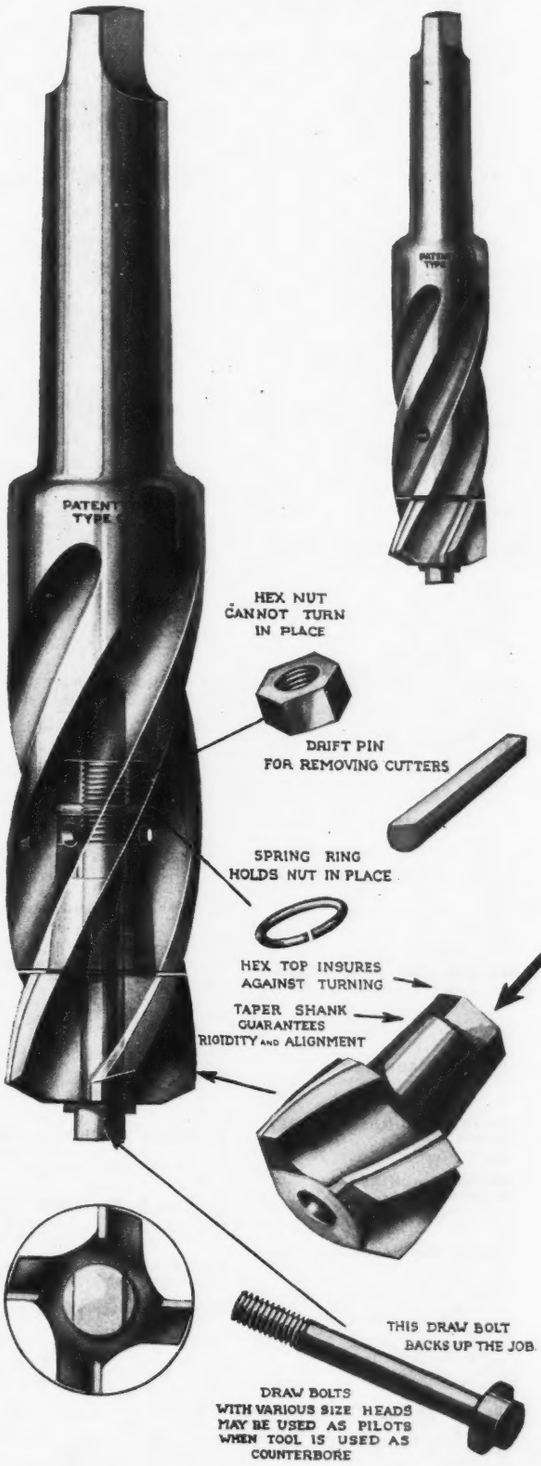
GEAR CUTTING MACHINES, HELICAL AND SPUR (SHAPER OR PLANER TYPE)
Fellows Gear Shaper Co., Springfield, Vt.

GEAR CUTTING MACHINES, SPIRAL PINION ROUGHER
Gleason Works, Rochester, N. Y.

GEAR CUTTING MACHINES, SPIRAL BEVEL
Gleason Works, Rochester, N. Y.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

Gairing Type "C" Core Drill


PATENT TYPE
HEX NUT CANNOT TURN IN PLACE
DRIFT PIN FOR REMOVING CUTTERS
SPRING RING HOLDS NUT IN PLACE
HEX TOP INSURES AGAINST TURNING
TAPER SHANK GUARANTEES RIGIDITY AND ALIGNMENT
THIS DRAW BOLT BACKS UP THE JOB
DRAW BOLTS WITH VARIOUS SIZE HEADS MAY BE USED AS PILOTS WHEN TOOL IS USED AS COUNTERBORE

For Enlarging and Finishing Holes in Forgings, Castings, etc.

GAIRING Tools
Are instantly adaptable,
Efficiently dependable,
At prices that are right.

Only necessary to replace cutter which maintains over-all length.

Standard sizes can be shipped from stock.

Quick service on special shanks to your specifications.

For information concerning our complete **Core Drill, Counterboring** and **Spot Facing** equipment, send for our No. 18 catalog.

THE GAIRING TOOL COMPANY, Inc.

DETROIT, MICHIGAN

REPRESENTATIVES:—

New York, Chicago, San Francisco, Indianapolis, Cleveland, Pittsburgh, Philadelphia, Baltimore, Cincinnati, Milwaukee, Minneapolis, St. Louis

GEAR CUTTING MACHINES, SPUR (ROTARY CUTTER)

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Gould & Eberhardt, Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

GEAR CUTTING MACHINES, WORMS AND WORM WHEELS (HOB)

Adams Co., Dubuque, Iowa.
Barber-Colman Co., Rockford, Ill.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Gould & Eberhardt, Newark, N. J.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Mch. Co., Newark, N. J.

GEAR HARDENING MACHINES

Gleason Works, Rochester, N. Y.

GEARS, CUT

Adams Co., Dubuque, Iowa.
Albaugh-Dover Mfg. Co., 2100 Marshall Blvd., Chicago.
Alling-Lander Co., Inc., Sodus, N. Y.
Atlantic Elevator Co., Inc., Philadelphia.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Machine Works, 1231 Spring Garden St., Philadelphia.
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Brown Co., A. & F., 79 Barclay St., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Gear Co., Cincinnati.
Connecticut Gears, Inc., Waterbury, Conn.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Davis, Rodney, Philadelphia.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Farrel Fdry. & Mch. Co., Inc., Buffalo, N. Y.
Fawcus Mach. Co., Pittsburgh.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Ganschow, Wm., Co., 16 No. Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Inc., Boston.
Harrington Co., Philadelphia.
Hindley Gear Co., Philadelphia.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1114 West Monroe St., Chicago.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Link-Belt Company, Chicago.
Machine Products Co., Cleveland.
Massachusetts Gear & Tool Co., 34 Nashua St., Woburn, Mass.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, 25, Mass.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Machine Co., Newark, N. J.
Niles-Bement-Pond Co., 111 Broadway, New York.
Nuttall Co., R. D., Pittsburgh, Pa.
Perkins Appliance Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia.
Poole Engineering & Machine Co., Baltimore, Md.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Mch. Co., Cleveland.
Toledo Mch. & Tool Co., Toledo.
Van Dorn & Dutton Co., Cleveland.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

GEARS, DOUBLE HELICAL, CUT

Bethlehem Steel Co., Bethlehem, Pa.
Connecticut Gears, Inc., Waterburry, Conn.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Farrel Fdry. & Mch. Co., Inc., Buffalo, N. Y.
Fawcus Machine Co., Pittsburgh.
Foote Bros. Gear & Mch. Co., 232 N. Curtis St., Chicago.
Horsburgh & Scott Co., Cleveland.
Meachem Gear Corp., Syracuse, N. Y.
Newark Gear Cutting Machine Co., Newark, N. J.
Niles-Bement-Pond Co., 111 Broadway, New York.
Philadelphia Gear Works, Philadelphia, Pa.

GEARS, FABRIC AND FIBRE

Boston Gear Works, Norfolk Downs, Quincy, Mass.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Diefendorf Gear Corp., Syracuse, N. Y.
Foote Bros. Gear & Mch. Co., 232 N. Curtis St., Chicago.
Ganschow, Wm., Co., 16 No. Morgan St., Chicago.
General Electric Co., Schenectady, N. Y.
Grant Gear Works, Inc., Boston.
James Mfg. Co., D. O., 1114 West Monroe St., Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Van Dorn & Dutton Co., Cleveland.

GEARS, FORGED

Nuttall Co., R. D., Pittsburgh.

GEARS, MOLDED

Brown Co., A. & F., 79 Barclay St., New York.
Foote Bros. Gear & Mch. Co., 232 N. Curtis St., Chicago.
Franklin Die-Casting Corp., Syracuse, N. Y.
Jones Fdry. & Mch. Co., W. A., 4409 West Roosevelt Road, Chicago.
Link-Belt Company, Chicago.
Philadelphia Gear Works, Philadelphia.
Poole Engineering & Machine Co., Baltimore, Md.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Van Dorn & Dutton Co., Cleveland.

GEARS, NON-METALLIC

Albaugh-Dover Mfg. Co., 2100 Marshall Blvd., Chicago.
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Ganschow, Wm., Co., 16 No. Morgan St., Chicago.
Grant Gear Works, Inc., Boston.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1114 West Monroe St., Chicago.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Newark Gear Cutting Machine Co., Newark, N. J.
Nuttall Co., R. D., Pittsburgh.
Philadelphia Gear Works, Philadelphia.
Simonds Mfg. Co., Pittsburgh.
Van Dorn & Dutton Co., Cleveland.

GEARS, RAWHIDE

Albaugh-Dover Mfg. Co., 2100 Marshall Blvd., Chicago.
Brown Co., A. & F., 79 Barclay St., New York.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Fawcus Machine Co., Pittsburgh.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Ganschow, Wm., Co., 16 No. Morgan St., Chicago.
Grant Gear Works, Inc., Boston.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1114 West Monroe St., Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 2, Mass.
Nuttall Co., R. D., Pittsburgh.
Philadelphia Gear Works, Philadelphia.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Van Dorn & Dutton Co., Cleveland.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

GEARS, WORM

Albaugh-Dover Mfg. Co., 2100 Marshall Blvd., Chicago.
Alling-Lander Co., Inc., Sodus, N. Y.
Atlantic Elevator Co., Inc., Philadelphia.
Baush Machine Tool Co., Springfield, Mass.
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Co., A. & F., 79 Barclay St., New York.
Cincinnati Gear Co., Cincinnati.
Connecticut Gears, Inc., Waterbury, Conn.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Fawcus Machine Co., Pittsburgh.
Foote Bros. Gear & Machine Co., 232 North Curtis St., Chicago.
Ganschow, Wm., Co., 16 No. Morgan St., Chicago.
Hindley Gear Co., Philadelphia.
Horsburgh & Scott Co., Cleveland.
James Mfg. Co., D. O., 1114 West Monroe St., Chicago.
Link-Belt Company, Chicago.
Meachem Gear Corp., Syracuse, N. Y.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Newark Gear Cutting Machine Co., Newark, N. J.
Nuttall Co., R. D., Pittsburgh.
Perkins Appliance Co., Springfield, Mass.
Philadelphia Gear Works, Philadelphia.
Poole Engineering & Machine Co., Baltimore, Md.
Simonds Mfg. Co., Pittsburgh.
Stahl Gear & Machine Co., Cleveland.
Van Dorn & Dutton Co., Cleveland.

GEAR TESTING MACHINERY

Adams Co., Dubuque, Iowa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davenport Machine Tool Co., Inc., Rochester, N. Y.
Ferner Co., R. Y., Washington, D. C.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Gleason Works, Rochester, N. Y.
Manufacturers Consulting Engineers, Syracuse, N. Y.
Morse Twist Drill & Mch. Co., New Bedford, Mass.

GENERATORS, ACETYLENE

Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.

GENERATORS, ELECTRIC

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

GENERATORS, GAS

American Gas Furnace Co., Elizabeth, N. J.

GIBS AND KEYS FOR CONNECTING RODS

Moltrup Steel Products Co., Beaver Falls, Pa.

GLUE HEATERS

Divine Bros. Co., Utica, N. Y.
General Electric Co., Schenectady, N. Y.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.

GRADUATING MACHINES

Ferner Co., R. Y., Washington, D. C.
Noble & Westbrook Mfg. Co., Hartford, Conn.

GREASE

Sun Oil Company, Philadelphia.

GREASE CUPS

Bowen Products Corp., Auburn, N. Y.
Link-Belt Company, Chicago.

GRINDING MACHINES, ABRASIVE BELT

Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Production Machine Co., Greenfield, Mass.

GRINDING MACHINES, BENCH

Athol Mch. & Foundry Co., Athol, Mass.
Blount, J. G., Co., Central Ave., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Fdry., Providence, R. I.
Cleveland Armature Works, Cleveland.
Diamond Machine Co., Providence, R. I.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Marathon Electric Mfg. Co., Wausau, Wis.
Marschke Mfg. Co., Indianapolis, Ind.
Neil & Smith Electric Tool Co., Cincinnati.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Walker Co., Inc., O. S., Worcester, Mass.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.

GRINDING MACHINES, CENTER

Diamond Mch. Co., Providence, R. I.
Neil & Smith Electric Tool Co., Cincinnati.
United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, CENTERLESS

Heim Grinder Co., Danbury, Conn.

GRINDING MACHINES, CHASER OR DIE

Geometric Tool Co., New Haven, Ct.

GRINDING MACHINES, CHUCKING

Bryant Chucking Grinder Co., Springfield, Vt.

GRINDING MACHINES, CUTTER

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Gear Cutting Mch. Co., Cincinnati.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Garvin Machine Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ingersoll Milling Machine Co., Rockford, Ill.
LeBlond Machine Tool Co., R. K., Cincinnati.
Modern Tool Co., Erie, Pa.
Newark Gear Cutting Machine Co., Newark, N. J.
Norton Co., Worcester, Mass.
Oesterlein Machine Co., Cincinnati.
Pratt & Whitney, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.
Union Twist Drill Co., Athol, Mass.
Walker Co., Inc., O. S., Worcester, Mass.
Waltham Machine Works, Waltham, Mass.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, CYLINDER

Heald Machine Co., 16 New Bond St., Worcester, Mass.
Foster Machine Co., Elkhart, Ind.

GRINDING MACHINES, CYLINDRICAL, PLAIN

Brown & Sharpe Mfg. Co., Providence, R. I.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Co., Worcester, Mass.
Pratt & Whitney, Hartford, Conn.

GRINDING MACHINES, CYLINDRICAL, UNIVERSAL

Brown & Sharpe Mfg. Co., Providence, R. I.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney, Hartford, Conn.
Thompson Grinder Co., Springfield, O.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, DIE SINKERS, PORTABLE

Keller Mechanical Engineering Corp., 74 Washington St., Brooklyn, N. Y.

GRINDING MACHINES, DISC

Badger Tool Co., Beloit, Wis.
Besly Co., Charles H., 120-B North Clinton St., Chicago.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Machine Co., Providence, R. I.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.
Rowbottom Machine Co., Waterbury, Conn.

GRINDING MACHINES, DRILL

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Heald Machine Co., 16 New Bond St., Worcester, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Sellers & Co., Inc., Wm., Philadelphia.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.

GRINDING MACHINES, FLOOR-STAND TYPE

Blount, J. G., Co., Central Ave., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Cleveland Armature Works, Cleveland.
Cleveland Stone Co., Cleveland.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Marschke Mfg. Co., Indianapolis, Ind.
Ransom Mfg. Co., Oshkosh, Wis.
Sterling Grinding Wheel Co., Tiffin, O.
United States Electrical Tool Co., Cincinnati.

GRINDING MACHINES, GAGE

Ferner Co., R. Y., Washington, D. C.
Steel Products Engineering Co., Springfield, O.

GRINDING MACHINES, HOB

Barber-Colman Co., Rockford, Ill.
Union Twist Drill Co., Athol, Mass.

GRINDING MACHINES, INTERNAL

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Bryant Chucking Grinder Co., Springfield, Vt.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Garvin Machine Co., Spring and Varick Sts., New York.
Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
Heald Machine Co., 16 New Bond St., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Neil & Smith Electric Tool Co., Cincinnati, O.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Taylor & Fenn Co., Hartford, Conn.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, KNIFE

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Mch. Co., Providence, R. I.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

Meachem Gear Service

Good gears, delivered promptly and at reasonable cost, characterize Meachem Gear Service. Our 36 years of gear-making experience, our 16,000 gear patterns comprising all the standard types and sizes that we have found are likely to be needed in a hurry, and our ample and modern gear-making equipment are all at your call for making the kind of gears you use, for we specialize on industrial gears.

You can depend on permanent satisfaction and Meachem quality, deliveries and price whether you want one gear or a thousand, in any size, type or material.

Send us blueprints or specifications and let us give you estimates without obligation on your typical gear requirements. Or better yet, send us a trial order to determine the many advantages of standardizing on Meachem Gear Service.

THE MEACHEM GEAR CORPORATION

We also make gears and pinions of Formica.

Sole manufacturers of **new process** RAWHIDE GEARS and PINIONS —Still made under the direction of the inventors and the men responsible for every stage in their development.

122-142 Dickerson Street, Syracuse, N. Y.

122

MEACHEM

GOOD INDUSTRIAL GEARS

GRINDING MACHINES, MULTIPLE SPINDLE
Bryant Chucking Grinder Co., Springfield, Vt.

GRINDING MACHINES, PATTERN-MAKERS' DISC
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.

GRINDING MACHINES, PIPE THREADING DIE
Bignall & Keeler Machine Works, Edwardsville, Ill.
Landis Mch. Co., Inc., Waynesboro, Pa.
National Machinery Co., Tiffin, O.

GRINDING MACHINES, PISTON RING
Badger Tool Co., Beloit, Wis.
Heald Machine Co., 16 New Bond St., Worcester, Mass.
Pedrick Tool & Mch. Co., 3639 No. Lawrence St., Philadelphia.

GRINDING MACHINES, PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York.

GRINDING MACHINES, PORTABLE ELECTRIC
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Haskins Co., K. G., 518½ W. Monroe St., Chicago.
Neil & Smith Elec. Tool Co., Cincinnati.
Stow Mfg. Co., Binghamton, N. Y.
Strand Mfg. Co., N. A., 5001 N. Lincoln St., Chicago.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tool Co., Cleveland.
Wisconsin Elec. Co., Racine, Wis.

GRINDING MACHINES, RADIAL BALL RACE, ETC.
Rivett Lathe & Grinder Corp., Brighton, Boston.

GRINDING MACHINES, RING WHEEL
Badger Tool Co., Beloit, Wis.
Besly & Co., Chas. H., 120-B Clinton St., Chicago.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.
Graham Mfg. Co., Providence, R. I.

GRINDING MACHINES, ROTARY SURFACE
Boston Scale & Mch. Co., Roxbury, Mass.
Heald Machine Co., 16 New Bond St., Worcester, Mass.
Pratt & Whitney, Hartford, Conn.

GRINDING MACHINES, SURFACE
Abrasive Mch. Tool Co., East Providence, R. I.
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Diamond Mch. Co., Providence, R. I.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Garvin Machine Co., Spring and Varick Sts., New York.
Heald Machine Co., 16 New Bond St., Worcester, Mass.
Newton Machine Tool Works, Inc., Philadelphia.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Newton Machine Tool Works, Hartford, Conn.
Norton Co., Worcester, Mass.
Pratt & Whitney, Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Rowbottom Machine Co., Waterbury, Conn.
Sommer & Adams Co., Cleveland.
Walker Co., Inc., O. S., Worcester, Mass.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, SWING
Cleveland Stone Co., Cleveland.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Sterling Grinding Wheel Co., Tiffin, O.

GRINDING MACHINES, TAP
Ferner Co., R. Y., Washington, D. C.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.

GRINDING MACHINES, TOOL AND CUTTER
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Baird Machine Co., Bridgeport, Conn.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Blount, J. G., Co., Central Ave., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Diamond Mch. Co., Providence, R. I.
Fafnir Bearing Co., New Britain, Conn.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Marschke Mfg. Co., Indianapolis, Ind.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., Cleveland, O.
Norton Co., Worcester, Mass.
Oesterlein Machine Co., Cincinnati.
Ransom Mfg. Co., Oshkosh, Wis.
Sellers & Co., Inc., Wm., Philadelphia.
Walker Co., Inc., O. S., Worcester, Mass.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Wisconsin Elec. Co., Racine, Wis.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, UNIVERSAL
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Thompson Grinder Co., Springfield, O.
Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich.
Woods Engineering Co., Alliance, O.

GRINDING MACHINES, UNIVERSAL, LATHE AND PLANER TOOLS
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Sellers & Co., Inc., Wm., Philadelphia.

GRINDING WHEELS
Abrasive Co., Bridesburg, Philadelphia.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Carborundum Co., Niagara Falls, N. Y.
Cleveland Stone Co., Cleveland.
Norton Co., Worcester, Mass.
Sterling Grinding Wheel Co., Tiffin, O.

GRINDSTONES
Cleveland Stone Co., Cleveland.

GUARDS FOR MACHINERY
Chicago Perforating Co., 2445 West 24th Place, Chicago.
Taylor-Shantz Co., Rochester, N. Y.
Wiesman Mfg. Co., Dayton, O.

GUARDS FOR PUNCH PRESSES, SAFETY
Taylor-Shantz Co., Rochester, N. Y.
Wiesman Mfg. Co., Dayton, O.

HAMMERS, AIR
Nazel Engineering & Machine Works, 4043 North Fifth St., Philadelphia.

HAMMERS, DROP
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Miner & Peck Mfg. Co., Derby, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.
Toledo Mch. & Tool Co., Toledo, O.
Williams, White & Co., Moline, Ill.

HAMMERS, HELVE
High Speed Hammer Co., Inc., Rochester, N. Y.

HAMMERS, PNEUMATIC
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.

HAMMERS, POWER
Beaudry Co., Inc., Everett, Mass.
Bradley & Son, Inc., C. C., Syracuse, N. Y.
High Speed Hammer Co., Inc., Rochester, N. Y.
Nazel Engineering & Machine Works, 4043 North Fifth St., Philadelphia.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
West Tire Setter Co., Rochester, N. Y.

HAMMERS, SOFT
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.

HAMMERS, SHELL NOSING
Beaudry Co., Inc., Everett, Mass.
Nazel Engineering & Machine Works, 4043 North Fifth St., Philadelphia.

HAMMERS, STEAM
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

HANGERS, SHAFT
American Pulley Co., Philadelphia.
Brown Co., A. & F., 79 Barclay St., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cresson-Morris Co., Philadelphia.
Fafnir Bearing Co., New Britain, Ct.
Hyatt Roller Bearing Co., Newark, N. J.
Link-Belt Company, Chicago.
New Departure Mfg. Co., Bristol, Conn.
Sellers & Co., Inc., Wm., Philadelphia.
S K F Industries, Inc., 165 Broadway, New York.
Skayef Ball Bearing Co., 165 Broadway, New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

HARDNESS TESTING INSTRUMENTS
Shore Instrument & Mfg. Co., Inc., Jamaica, N. Y.

HEATING AND VENTILATING APPARATUS
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y.

HEAT-TREATMENT OF STEEL
American Metal Treatment Co., Elizabeth, N. J.
Bennett Metal Treating Co., Elmwood, Conn.
Machine Products Co., Cleveland.
Nuttall Co., R. D., Pittsburgh.

HOBBING MACHINES
See Gear Cutting Machines, Helical and Spur (Hob) and Gear Cutting Machines, Worm and Worm Wheel (Hob).

HOBBING MACHINES, MULTIPLE SPLINE
Sommer & Adams Co., Cleveland.

HOBS
Barber-Colman Co., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clark Cutter Co., Detroit.
Gould & Eberhardt, Newark, N. J.
Greenfield Tap & Die Corp., Greenfield, Mass.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Mch. Co., Newark, N. J.
Union Twist Drill Co., Athol, Mass.

HOISTS, AIR
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.
Whiting Corp., Harvey, Ill.

HOISTS, CHAIN, ETC.
Ford Chain Block Co., Philadelphia.
Harrington Co., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Roeper Crane & Hoist Works, Reading, Pa.

HOISTS, ELECTRIC
Link-Belt Company, Chicago.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pawling & Harnischfeger Co., Milwaukee, Wis.
Roeper Crane & Hoist Works, Reading, Pa.
Thomas Elevator Co., 24 So. Hoyne Ave., Chicago, Ill.

HOISTS, PORTABLE
Canton Fdry. & Mch. Co., Canton, O.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.

HYDRAULIC MACHINERY AND TOOLS
Bethlehem Steel Co., Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Cresson-Morris Co., Philadelphia.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.
Williams, White & Co., Moline, Ill.

INDEX CENTERS
See also Milling Machines, Horizontal, Universal.
Abrasive Mch. Tool Co., East Providence, R. I.
Knight Mchy. Co., W. B., St. Louis.

INDICATORS, SPEED
Brown & Sharpe Mfg. Co., Providence, R. I.
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Greene, Tweed & Co., 109 Duane St., New York.
Starrett Co., L. S., Athol, Mass.
Veeder Mfg. Co., 39 Sargent St., Hartford, Conn.

INDICATORS, TEST
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., Providence, R. I.
Ferner Co., R. Y., Washington, D. C.
Lowe, H. A., Cleveland.
Norton Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.
Wallace Bros., 160 N. Wells St., Chicago.

INDUSTRIAL ILLUMINATION
Cooper-Hewitt Electric Co., Hoboken, N. J.

INTENSIFIERS, HYDRAULIC
Elmes Eng'g Works, Chas. E., 222 N. Morgan St., Chicago.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

JACKS, HYDRAULIC
Watson-Stillman Co., 192 Fulton St., New York.

JACKS, PLANER
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.

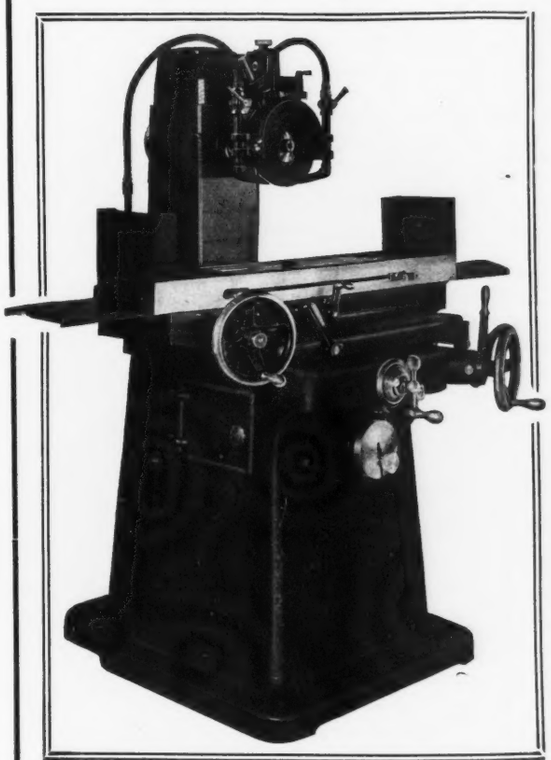
JIGS AND FIXTURES
American Tool & Mfg. Co., Urbana, Ohio.
Banner Die, Tool & Stamping Co., Columbus, O.
Brock Tool & Mfg. Works, Arthur, Jr., Philadelphia.
Columbus Die Tool & Mch. Co., Columbus, O.
Davenport, Mfg. Co., Meadville, Pa.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.
Ingersoll Milling Machine Co., Rockford, Ill.
Logansport Mch. Co., 529 Market St., Logansport, Ind.
Manufacturers' Consulting Engineers, Syracuse, N. Y.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Moline Tool Co., Moline, Ill.
Orrell, R. W., Mch. Co., Flint, Mich.
Pratt & Whitney Co., Hartford, Conn.
Production Engineering Corp., Canastota, N. Y.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Reynolds Mch. Co., Masaillon, O.
Sommer & Adams Co., Cleveland.
Steel Products Engineering Co., Springfield, Ohio.
Taylor-Shantz Co., Rochester, N. Y.
Wade-American Tool Co., Waltham, Mass.

KETTLES, SODA
Brown & Sharpe Mfg. Co., Providence, R. I.

KEYSEATERS
Baker Bros., Inc., Toledo, O.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Davis Keyseater Co., Rochester, N. Y.
Lapointe Machine Tool Co., Hudson, Mass.
Mitts & Merrill, 843 Water St., Saginaw, Mich.
Morton Mfg. Co., Muskegon Heights, Mich.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

For Precision, For Production, For Economy



The Wilmarth & Morman, No. 78 Automatic Surface Grinders

This rigid, powerful, adaptable machine has a number of highly practical special features which enable it to work more accurately, more speedily and more profitably than less highly developed grinders.

Note the advantages of the double elevating wheel screws, the special built-in wheel trueing device, etc. Belt or motor drive, capacity 8″ x 22″ x 11″; wheel 10″ x ¾″.

Send for circular S. G. 1006

WILMARTH & MORMAN CO.

Manufacturers of Precision Grinding Machinery since 1900

1180 Monroe Avenue, N. W. GRAND RAPIDS, MICH.

No. 5 Double Spindle BELT DRIVEN Polishing Lathe

An exceptionally rigid and substantial machine. Spindles 2″ diameter full length, except where wheels go on. Completely Ball Bearing (10 in all), even to the loose pulleys.

4 sizes single spindle belted machines
4 sizes double spindle belted machines
3 sizes motor driven machines

THE MITCHELL ENGINEERING CO.
Springfield, Ohio

WIRE STRAIGHTENING AND CUTTING MACHINERY

For All Sizes, Shapes and Kinds of Wire

THE F. B. SHUSTER CO., New Haven, Conn.
Formerly John Adt & Son Established 1866

BUTTERFIELD

TAPS AND DIES

Accurate, Clean Cut, Economical Thread Cutting Tools.
SEND FOR THE CATALOG
BUTTERFIELD & CO., Division, Union Twist Drill Co.
Derby Line, Vermont
Chicago, 11 S. Clinton St. New York, 62 Reade St.

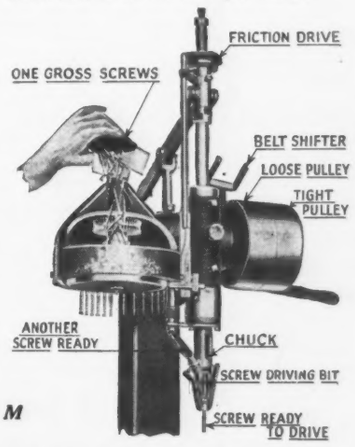
Drives Screws as Fast as Work can be Fed

Dump a gross or more of wood or machine screws into the hopper of the Reynolds Magazine Feed Automatic Screw Driving Machine; press a foot lever and the screws are driven home just as fast as the work can be placed in position.

With this machine a boy can ordinarily set 800 to 1200 screws per hour, and on certain classes of work expert operators have recorded 2000 screws per hour.

The Reynolds is inexpensive and in a very short time its first cost is earned many times over.

Tell us about your work (over-all dimensions, gauge and length of screws used) and we'll be glad to tell you about a Reynolds suited to your needs.



Department M

THE REYNOLDS MACHINE CO.
MASSILLON, OHIO

KEYSEATERS, PORTABLE
Burr & Son, John T., Brooklyn, N. Y.

KEYS, MACHINE
Moltrup Steel Products Co., Beaver Falls, Pa.
Morton Mfg. Co., Muskegon Heights, Mich.
Smith & Serrell, Newark, N. J.
Whitney Mfg. Co., Hartford, Conn.
Williams, J. H., & Co., Buffalo, N. Y.

KNIVES, MACHINE
Coes Wrench Co., Worcester, Mass.

KNURL HOLDERS
Graham Mfg. Co., Providence, R. I.
Pratt & Whitney, Hartford, Conn.

KNURLING TOOLS
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Pratt & Whitney, Hartford, Conn.
Williams, J. H., & Co., Buffalo, N. Y.

LAMP GUARDS, ETC.
McCrosky Tool Corp., Meadville, Pa.

LAMPS, ELECTRIC
Cooper-Hewitt Electric Co., Hoboken, N. J.
General Electric Co., Schenectady, N. Y.

LAPPING MACHINES, POWER
Builders Iron Foundry, Providence, R. I.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.

LATHE ATTACHMENTS
American Tool Works Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Bradford Mch. Tool Co., Cincinnati.
Carroll & Jamieson Machine Tool Co., Batavia, Ohio.
Champion Tool Works, 4955 Spring Grove Ave., Cincinnati.
Cisco Mch. Tool Co., Cincinnati.
Diamond Machine Co., Providence, R. I.
Fitchburg Machine Works, Fitchburg, Mass.
Flather Co., Nashua, N. H.
Garvin Machine Co., Spring and Varick St., New York.
Greaves-Klusman Tool Co., Cincinnati.
Hendey Mch. Co., Torrington, Conn
LeBlond Mch. Tool Co., R. K., Cincinnati.
Lodge & Shipley Machine Tool Co., Cincinnati.
Monarch Machine Tool Co., 209 Oak St., Sidney, O.
Mueller Mch. Tool Co., Cincinnati.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Rockford Tool Co., Rockford, Ill.
Sebastian Lathe Co., Cincinnati.
Seneca Falls Machine Co., Seneca Falls, N. Y.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Stark Tool Co., Waltham, Mass.
Vandyck-Churchill Co., 149 Broadway, New York.

LATHE DOGS
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Ready Tool Co., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

LATHE DOGS, SAFETY
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Williams, J. H., & Co., Buffalo, N. Y.

LATHES, PLANER AND SHAPER TOOLS
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
McCrosky Tool Corp., Meadville, Pa.
O. K. Tool Holder Co., Shelton, Conn.
Ready Tool Co., Bridgeport, Conn.
Sebastian Lathe Co., Cincinnati.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

LATHES, AUTOMATIC
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Jones & Lamson Machine Co., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Cincinnati, O.
National Acme Co., Cleveland, O.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney, Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Rockford Machine Tool Co., Rockford, Ill.
South Bend Machine Wks., Inc., South Bend, Ind.

LATHES, AUTOMATIC SCREW THREADING
Automatic Machine Co., Bridgeport, Conn.

LATHES, AXLE
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, BENCH
Ames Co., B. C., Waltham, Mass.
Diamond Mch. Co., Providence, R. I.
Elgin Tool Works, Inc., Elgin, Ill.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hjorth Lathe & Tool Co., Boston.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Seneca Falls Machine Co., Seneca Falls, N. Y.
South Bend Lathe Works, Inc., South Bend, Ind.
Stark Tool Co., Waltham, Mass.
Wade-American Tool Co., Waltham, Mass.

LATHES, BORING
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
LeBlond, R. K., Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, BRASS WORKERS
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Dreses Machine Co., Cincinnati.
Garvin Mch. Co., Spring and Varick Sts., New York.
Seneca Falls Machine Co., Seneca Falls, N. Y.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Warner & Swasey Co., Cincinnati.

LATHES, CAR WHEEL
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, CRANKSHAFT
American Tool Works Co., Cincinnati.
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
LeBlond Machine Tool Co., R. K., Cincinnati.
Lodge & Shipley Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Wickes Bros., Saginaw, Mich.

LATHES, DOUBLE-END
Rockford Milling Machine Co., Rockford, Ill.

LATHES, ENGINE
American Tool Works Co., Cincinnati.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Betts Machine Co., Rochester, N. Y.
Bradford Mch. Tool Co., Cincinnati.
Carroll, A. V., Machine Tool Co., Cincinnati.
Carroll & Jamieson Machine Tool Co., Batavia, O.
Champion Tool Works, 4955 Spring Grove Ave., Cincinnati.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati.
Cisco Machine Tool Co., Cincinnati.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Flather Co., Nashua, N. H.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Hendey Mch. Co., Torrington, Conn.
LeBlond Machine Tool Co., R. K., Cincinnati.
Lehmann Machine Co., St. Louis, Mo.
Lodge & Shipley Machine Tool Co., Cincinnati.
Monarch Machine Tool Co., 209 Oak St., Sidney, O.
Morris Machine Tool Co., Cincinnati.
Mueller Mch. Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney, Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Rockford Lathe & Drill Co., Rockford, Ill.
Rockford Tool Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Sebastian Lathe Co., Cincinnati.
Seneca Falls Machine Co., Seneca Falls, N. Y.
Sidney Machine Tool Co., Sidney, O.
South Bend Lathe Works, Inc., South Bend, Ind.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Walcott Lathe Co., Jackson, Mich.
Wickes Bros., Saginaw, Mich.
Willard Mch. Tool Co., Cincinnati.

LATHES, EXTENSION BED AND GAP
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Harrington Co., Philadelphia.
LeBlond, R. K., Machine Tool Co., Cincinnati.
Sebastian Lathe Co., Cincinnati.
South Bend Lathe Works, Inc., South Bend, Ind.

LATHES, FOOT POWER
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Seneca Falls Machine Co., Seneca Falls, N. Y.

LATHES, GUN BORING
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Niles-Bement-Pond Co., 111 Broadway, New York.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, Ohio.

LATHES, PATTERNMAKERS'
Blount, J. G., Co., Central Ave., Everett, Mass.
Seneca Falls Machine Co., Seneca Falls, N. Y.
South Bend Lathe Wks., Inc., South Bend, Ind.

LATHES, PULLEY
Avey Drilling Mch. Co., Cincinnati.

LATHES, SHAFT
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia.

LATHES, SPEED
Blount, J. G., Co., Central Ave., Everett, Mass.
Diamond Machine Co., Providence, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.

LATHES, SPINNING
Adriance Machine Co., Inc., 78 Richards St., Brooklyn, N. Y.
Bliss Co., E. W., Brooklyn, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
See also Chucking Machines.

LATHES, TURRET
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Betts Machine Co., Rochester, N. Y.
Bullard Machine Tool Co., Bridgeport, Conn.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Dreses Machine Tool Co., Cincinnati.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati.
International Mch. Tool Co., Indianapolis, Ind.
Jones & Lamson Machine Co., Springfield, Vt.
LeBlond, R. K., Machine Tool Co. Cincinnati.
Lodge & Shipley Machine Tool Co., Cincinnati.
Morris Mch. Tool Co., Cincinnati.
Pratt & Whitney, Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Stark Tool Co., Waltham, Mass.
Steinle Turret Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland.

LATHES, WOODWORKERS'
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.

LEATHER BELTING, ROUND
See Belting Round Leather.

LEVELS
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Pratt & Whitney Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.

LIGHTING
Cooper-Hewitt Electric Co., Hoboken, N. J.

LUBRICANTS
Dixon Crucible Co., Joseph, Jersey City, N. J.
International Chemical Co., Philadelphia.
Oakley Chemical Co., 26 Thames St., New York.
Sun Oil Company, Philadelphia.

LUBRICATORS
Besly & Co., Chas. H., 120-B North Clinton St., Chicago.
Bowen Products Corp., Auburn, N. Y.
Greene, Tweed & Co., 109 Duane St., New York.

MACHINISTS' SMALL TOOLS
See Calipers, Hammers, Wrenches, Drills, Taps, etc.

MALLETS, RAWHIDE
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.

MANDRELS, EXPANDING AND SOLID
See Arbors and Mandrels, Expanding and Solid.

MARKING MACHINES
Grant Mfg. & Mch. Co., N. W., Station, Bridgeport, Conn.
Noble & Westbrook Mfg. Co., Hartford, Conn.
V & O Press Co., Hudson, N. Y.

MEASURING MACHINES, PRECISION
Federal Products Corp., Providence, R. I.
Ferner Co., R. Y., Washington, D. C.
Norma Co. of America, Long Island City, N. Y.
Pratt & Whitney, Hartford, Conn.

METALS, BEARING
See also Bearings, Bronze, Babbitt, etc., and Bushings, Brass, Bronze, etc.

METALS, PERFORATED
Chicago Perforating Co., 2445 West 24th Place, Chicago.

MICROMETERS
Almond Mfg. Co., T. R., Ashburnham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Ferner Co., R. Y., Washington, D. C.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

MILLING AND DRILLING MACHINES, UPRIGHT
See Drilling and Milling Machines, Vertical.

MILLING ATTACHMENTS
Adams Co., Dubuque, Iowa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. C., Oakley, Cincinnati.
Elgin Tool Works, Inc., Elgin, Ill.
Garvin Machine Co., Spring and Varick Sts., New York.
Hendey Mch. Co., Torrington, Conn.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati.
Oesterlein Mch. Co., Cincinnati.
Reed-Prentice Co., Worcester, Mass.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Rockford Milling Machine Co., Rockford, Ill.
Taylor & Fenn Co., Hartford, Conn.
United States Machine Tool Co., Cincinnati.
Whitney Mfg. Co., Hartford, Conn.

MILLING MACHINES, AUTOMATIC
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Ingersoll Milling Machine Co., Rockford, Ill.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

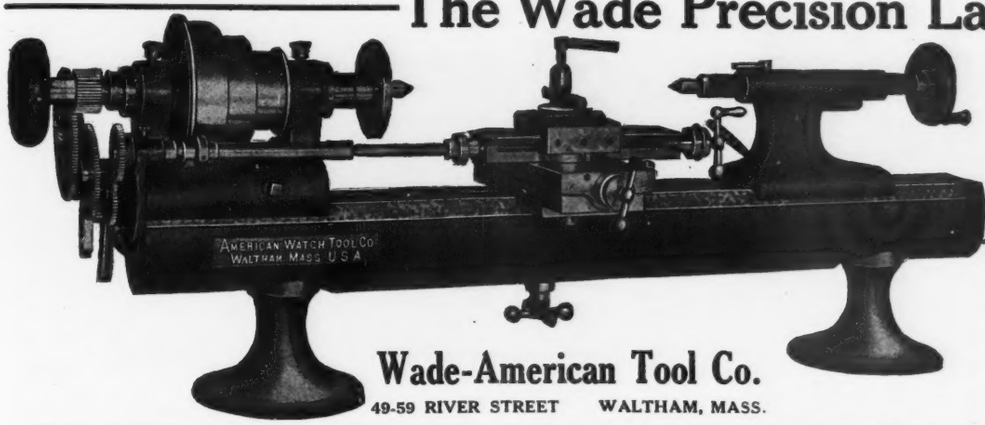
MILLING MACHINES, BENCH
Ames Co., B. C., Waltham, Mass.
Burke Mch. Tool Co., 516 Sandusky St., Conneaut, Ohio.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Pratt & Whitney Co., Hartford, Conn.
Rockford Milling Machine Co., Rockford, Ill.
Stark Tool Co., Waltham, Mass.

MILLING MACHINES, CIRCULAR CONTINUOUS
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Gould & Eberhardt, Newark, N. J.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Newton Machine Tool Works, Inc., Philadelphia.

MILLING MACHINES, DUPLEX
Garvin Mch. Co., Spring and Varick Sts., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Knight Mchy. Co., W. B., St. Louis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Taylor & Fenn Co., Hartford, Conn.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

The Wade Precision Lathe



is a universal precision tool on which you can turn, thread, drill, bore, face, mill and grind without resetting the work.

This machine is widely used in place of heavy, expensive machines by toolmakers and precision manufacturers. Let us send details.

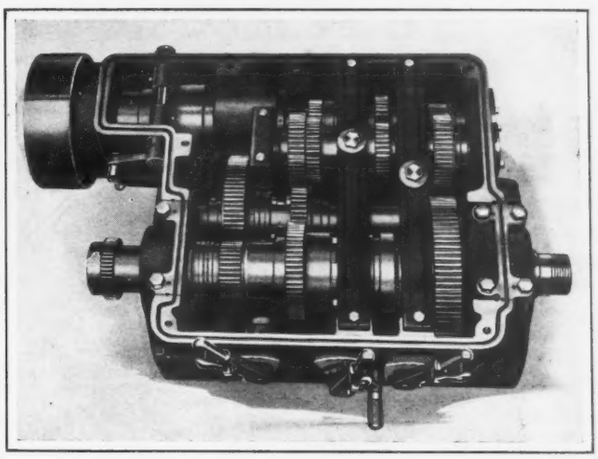
Wade-American Tool Co.
49-59 RIVER STREET WALTHAM, MASS.

THREADS
Chasing
Hobbing
Grinding

Automatic Threading Lathes, Automatic Hob Thread Millers, Coulter Multiple Spindle Profilers, Coulter Shaping Planers, Special Machine Tools

If threading operations are important in your manufacturing processes, send for details of the entire line.

The Automatic Machine Co., Bridgeport, Conn.



The Cisco New Geared Head Lathe

Greater Simplicity and Economy in operation is obtained because:

1. Any one of the twelve speeds may be obtained without stopping the lathe.
2. Entire mechanism of head runs in oil thus saving oiling time.
3. All shafts are mounted in S.K.F. ball bearings thereby cutting to a minimum power costs.
4. A Control at both Head and Apron starts and stops the Lathe, no lost motion.

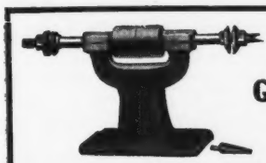
We can show you many other savings if you will write us for details.

CISCO MACHINE TOOL CO., Cincinnati, O.

CINCINNATI LATHES

Give longest satisfactory service, which explains the unlimited confidence users place in them. Unlimited feeds. Standard, odd or metric threads, simply by shifting two levers. Sizes 16" to 30" cone type or geared head. Send for details. Cable address "Cintilathe."

THE CINCINNATI LATHE & TOOL CO.
OAKLEY, CINCINNATI, OHIO, U. S. A.



"Pull" Countershafts Grinding and Polishing Machinery

BUILDERS IRON FOUNDRY, Providence, R. I.

Fast, Accurate Die Filing

The Oliver Die-Making Machine saws and files dies, punch pads, stripper plates and gages; it laps hardened pieces much more rapidly than hand lapping. Greatly reduces the costs of templets, irregular shaped cams, experimental parts.

Send for Supply Circular No. 20—lists stock of saws, files, lapping stones of various shapes and sizes.

Oliver Instrument Co.
1410 E. Maumee Street
Adrian, Mich., U.S.A
New York Branch, 139 Lafayette St. Tel. Canal 3982. C. D. Proctor, District Sales Representative.

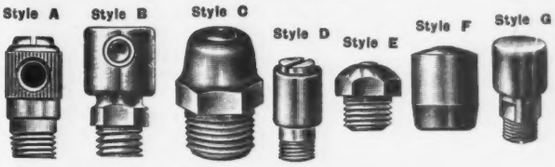
Advertising Personality

Is reflected in our line of manufacture. Common and horse sense embodied in every style and size of oiler with a mission to give service is the object of

Tucker Oil Hole Covers

Catalogue No. 6 for your literature

Style A has Rotary Sleeve
Style B has Rotary Head



W. M. & C. F. TUCKER, Hartford, Conn.
FOREIGN AGENTS: Fenwick Freres & Co., Paris, France.
Alfred Herbert, Ltd., Yokohama, Japan.

MILLING MACHINES, HAND
Brown & Sharpe Mfg. Co., Providence, R. I.
Burke Mch. Tool Co., 516 Sandusky St., Conneaut, Ohio.
Garvin Machine Co., Spring and Varick Sts., New York.
Kent-Owens Mch. Co., Toledo, O.
Pratt & Whitney Co., Hartford, Conn.
Rockford Milling Machine Co., Rockford, Ill.
United States Machine Tool Co., Cincinati, Ohio.
Whitney Mfg. Co., Hartford, Conn.

MILLING MACHINES, HORIZONTAL, PLAIN
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Garvin Machine Co., Spring and Varick Sts., New York.
Gooley & Edlund, Inc., Cortland, N. Y.
Hendey Mch. Co., Torrington, Conn.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati.
McCrosky Tool Corp., Meadville, Pa.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Machine Co., Cincinnati.
Reed Prentice Co., Worcester, Mass.
Rockford Milling Machine Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

MILLING MACHINES, HORIZONTAL, UNIVERSAL
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Oakley, Cincinnati.
Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich.
Hendey Mch. Co., Torrington, Conn.
Kearney & Trecker Corp., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati.
McCrosky Tool Corp., Meadville, Pa.
Oesterlein Machine Co., Cincinnati.
Rockford Milling Machine Co., Rockford, Ill.
Rowbottom Mch. Co., Waterbury, Ct.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

MILLING MACHINES, LINCOLN TYPE
Brown & Sharpe Mfg. Co., Providence, R. I.
Garvin Machine Co., Spring and Varick Sts., New York.
Hendey Mch. Co., Torrington, Conn.
Pratt & Whitney, Hartford, Conn.
Reynolds Mch. Co., Massillon, O.

MILLING MACHINES, MULTIPLE SPINDLE
Automatic Mch. Co., Bridgeport, Ct.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Ingersoll Milling Machine Co., Rockford, Ill.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

MILLING MACHINES, PORTABLE
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Newton Machine Tool Works, Inc., Philadelphia.
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

MILLING MACHINES, SPLINE
Pratt & Whitney Co., Hartford, Conn.

MILLING MACHINES, VERTICAL
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Garvin Machine Co., Spring and Varick Sts., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Corp., Milwaukee, Wis.
Knight Mchy. Co., W. B., St. Louis.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Co., Worcester, Mass.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Taylor & Fenn Co., Hartford, Conn.

MILLING TOOLS, HOLLOW ADJUSTABE
Geometric Tool Co., New Haven, Ct.

MODEL AND EXPERIMENTAL WORK
See Special Machinery and Tools.

MOLDING MACHINES
Adams Co., Dubuque, Iowa.
Hanna Engineering Works, 1763 Elston Ave., Chicago.

MOTORS, ELECTRIC
Century Electric Co., St. Louis, Mo.
Cleveland Armature Works, Cleveland.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., Schenectady, N. Y.
Marathon Electric Mfg. Co., Wausau, Wis.
Master Electric Co., 448 First St., Dayton, O.
Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

NAME PLATES, CAST BRONZE
Noble & Westbrook Mfg. Co., Hartford, Conn.
Schwerdtle Stamp Co., Bridgeport, Conn.

NAME PLATES, ETCHED
Noble & Westbrook Mfg. Co., Hartford, Conn.
Schwerdtle Stamp Co., Bridgeport, Conn.

NAME PLATES, STAMPED
Noble & Westbrook Mfg. Co., Hartford, Conn.
Schwerdtle Stamp Co., Bridgeport, Conn.

NIPPLE THREADING MACHINERY
Bethlehem Steel Co., Bethlehem, Pa.
Bignall & Keeler Machine Works, Edwardsville, Ill.
Landis Machine Co., Inc., Waynesboro, Pa.
Merrell Mfg. Co., 15 Curtis St., Toledo, O.
Murchey Mch. & Tool Co., 34 Porter St., Detroit.
Saunders' Sons, Inc., D., Yonkers, N. Y.

NUTS, CASTELLATED
National Acme Co., Cleveland, O.

NUT TAPPERS
See Bolt and Nut Machinery.

ODOMETERS
Veeder Mfg. Co., 39 Sergeant St., Hartford, Conn.

OIL CUPS
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Bowen Products Corp., Auburn, N. Y.
Gits Bros. Mfg. Co., 1911 South Kilbourne Ave., Chicago.
Tucker, W. M. & C. F., Hartford, Conn.

OILERS
Hanna Engineering Co., 133 No. 3rd St., Reading, Pa.

OILERS, LOOSE PULLEY
Brown Engineering Co., 133 No. 3rd St., Reading, Pa.

OIL EXTRACTORS
DeLaval Separator Co., 165 Broadway, New York.
Tolhurst Mch. Works, Troy, N. Y.

OIL GROOVING TOOLS
Hanson-Whitney Machine Co., Hartford, Conn.

OIL HOLE COVERS
Bowen Products Corp., Auburn, N. Y.
Gits Bros. Mfg. Co., 1911 South Kilbourne Ave., Chicago.
Tucker, W. M. & C. F., Hartford, Conn.

OILS, LUBRICATING
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Sun Oil Company, Philadelphia.

OILS, QUENCHING AND TEMPERING
Sun Oil Company, Philadelphia.

OILS, SOLUBLE
See Compound, Cutting, Grinding, etc.

OVENS, BAKING
American Gas Furnace Co., Elizabeth, N. J.
General Electric Co., Schenectady, N. Y.

OVENS, TEMPERING
General Electric Co., Schenectady, N. Y.

OXY-ACETYLENE APPARATUS
See Welding and Cutting Oxy-Acetylene Equipment.

OXYGEN
Air Reduction Sales Co., 342 Madison Ave., New York.
Linde Air Products Co., 30 E. 42nd St., New York.

PACKING LEATHER
Chicago Rawhide Mfg. Co., 1309 Elson Ave., Chicago.

PARALLELS
Walker Co., Inc., O. S., Worcester, Mass.

PATENTS
Parker, C. L., Washington, D. C.

PATTERN SHOP MACHINERY
Crescent Machine Co., 56 Main St., Leetonia, O.

PATTERNS, METAL
Grant Mfg. & Machine Co., N. W., Station, Bridgeport, Conn.
Mummert-Dixon Co., Hanover, Pa.
Sweet & Doyle Foundry & Mch. Co., Troy, Green Island, N. Y.

PATTERNS, WOOD
Sweet & Doyle Fdry. & Mch. Co., Troy, Green Island, N. Y.
V & O Press Co., Hudson, N. Y.

PENCILS, DRAWING
American Lead Pencil Co., 237 Fifth Ave., New York.
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Dixon Crucible Co., Joseph, Jersey City, N. J.

PHOSPHOR BRONZE
See Bronze.

PINION CUTTERS, AUTOMATIC
Wade American Tool Co., Waltham, Mass.

PINIONS, FORGED
See Gears, Forged.

PIPE, STEEL
National Tube Co., Pittsburgh.

PIPE BENDING TOOLS
Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

PIPE CUTTING AND THREADING MACHINES
Armstrong Mfg. Co., Bridgeport, Conn.
Bignall & Keeler Machine Works, Edwardsville, Ill.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Foote-Burt Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Machine Co., Inc., Waynesboro, Pa.
Merrell Mfg. Co., 15 Curtis St., Toledo, O.
Murchey Mch. & Tool Co., 34 Porter St., Detroit.
Niles-Bement-Pond Co., 111 Broadway, New York.
Saunders' Sons, Inc., D., Yonkers, N. Y.
Williams Tool Corp., Erie, Pa.

PLANER ATTACHMENTS
Cincinnati Planer Co., Cincinnati.
Gray Co., G. A., Cincinnati.
Hanson-Whitney Machine Co., Hartford, Conn.

PLANERS
American Tool Works Co., Cincinnati.
Bethlehem Steel Co., Bethlehem, Pa.
Betts Machine Co., Rochester, N. Y.
Cincinnati Planer Co., Cincinnati.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Gray Co., G. A., Cincinnati.
Liberty Mch. Tool Co., Hamilton, O.
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Co., Worcester, Mass.
Rockford Mch. Tool Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Sellers & Co., Inc., Wm., Philadelphia.
Woodward & Powell Planer Co., Worcester, Mass.

PLANERS, CRANK
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Newton Machine Tool Works, Inc., Philadelphia.

PLANERS, OPEN-SIDE
Automatic Mch. Co., Bridgeport, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Cincinnati Planer Co., Cincinnati.
Liberty Mch. Tool Co., Hamilton, O.

PLANERS, PORTABLE
Morton Mfg. Co., Muskegon Heights, Mich.
Underwood Corp., H. B., Philadelphia.

PLANERS, ROTARY
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Machine Co., 3639 No. Lawrence St., Philadelphia.
Underwood Corp., H. B., Philadelphia.

PLATE ROLLS
Bethlehem Steel Co., Bethlehem, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Wicks Bros., Saginaw, Mich.

PLATES, STEEL
Moltrup Steel Products Co., Beaver Falls, Pa.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

PLATES, SURFACE
Brown & Sharpe Mfg. Co., Providence, R. I.

PNEUMATIC DIE CUSHIONS FOR POWER PRESSES
Marquette Tool & Mfg. Co., 321 W. Ohio St., Chicago.

PNEUMATIC TOOLS
Chicago Penumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.
Logansport Mch. Co., 529 Market St., Logansport, Ind.

POLISHING MACHINES
Abbott Ball Co., Elmwood, Hartford, Conn.
Badger Tool Co., Beloit, Wis.
Besly & Co., Charles H., 120-B North Clinton St., Chicago.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Cleveland Stone Co., Cleveland.
Diamond Mch. Co., Providence, R. I.
Gardner Machine Co., 414 E. Gardner St., Beloit, Wis.
Marschke Mfg. Co., Indianapolis, Ind.
Mitchell Engineering Co., Springfield, Ohio.
Production Machine Co., Greenfield, Mass.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., Cincinnati.

POLISHING WHEELS
Divine Bros. Co., Utica, N. Y.

POTS, ANNEALING
Farrell-Cheek Steel Foundry Co., Sandusky, O.

PRESS BRAKES
Cincinnati Shaper Co., Cincinnati.
Loy & Nawrath Div. Birmingham Iron Fdry., Derby, Conn.

PRESSES, ARBOR
American Broach & Machine Co., Ann Arbor, Mich.
Atlas Press Co., Kalamazoo, Mich.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Logansport Mch. Co., 529 Market St., Logansport, Ind.
Lucas Machine Tool Co., Cleveland.
Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
Southwark Foundry & Machine Co., Philadelphia.

PRESSES, BROACHING
Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
American Broach & Machine Co., Ann Arbor, Mich.
Ams, Max, Machine Co., 101 Park Ave., New York.
Atlas Press Co., Kalamazoo, Mich.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgetown, N. J.
Lucas Machine Tool Co., Cleveland, O.
Oilgear Co., Milwaukee, Wis.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Machine & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.
Watson-Stillman Co., 192 Fulton St., New York.

PRESSES, DROP
See Hammers, Drop.

PRESSES, FOOT
Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Baird Mch. Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Etna Machine Co., Toledo, O.
Ferracute Mch. Co., Bridgeton, N. J.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Shuster Co., F. B., New Haven, Conn.
Toledo Machine & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

PRESSES, FORGING
Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Ams, Max, Machine Co., 101 Park Ave., New York.
Bethlehem Steel Co., Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgeton, N. J.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

PRESSES, HYDRAULIC
Bethlehem Steel Co., Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Farrel Fdry. & Mch. Co., Inc., Buffalo, N. Y.

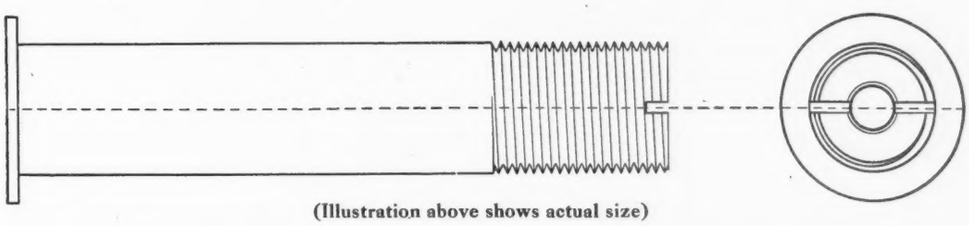
ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

SUN OILS

WINS AGAIN!

Saved 7 cents a gallon on cutting oil

A very exacting piece of work done better and quicker with Sunoco Emulsifying Cutting Oil



(Illustration above shows actual size)

NATURE OF WORK:
PLUNGER PIN FOR ELECTRIC SIGNAL SWITCH. SEVEN OPERATIONS NECESSARY TO COMPLETE EACH PIN. STOCK USED WAS NORWAY IRON.

TYPE OF MACHINE:
WARNER & SWASEY TURRET LATHE.

PRODUCTION RATE.
SPINDLE SPEED—400 R. P. M. CUTTING FEED — 8" PER MINUTE. TWENTY PIECES PER HOUR WERE CUT, AND FIVE HUNDRED PIECES WERE THREADED FOR EACH GRINDING OF CHASER. THE BOX TOOL WAS GROUND TWICE A DAY.

OIL USED:
1 PART SUNOCO EMULSIFYING CUTTING OIL TO 10 PARTS OF WATER.

Tests like this are of value to you. They show you how, under normal working conditions, Sunoco Emulsifying Cutting Oil is saving time and money and doing more satisfactory work for its many users. You can't afford not to use Sunoco in your shop if it will do these things for you.

In addition to money saved, longer tool life, and better products with Sunoco Emulsifying Cutting Oil, there is the health and comfort of your employees to be considered. Sunoco is a pure, soluble cutting oil; free from animal or vegetable fatty acids which frequently cause skin infections. It forms a lasting emulsion and has an exceptionally high lubricating and cooling value.

We'd like to have you test Sunoco in your shop. Write our nearest office for the facts, and for our pamphlet, "In Your Machine Shop."

SUN OIL COMPANY, *Philadelphia*

SUN OIL COMPANY, Limited, MONTREAL

Producers of the famous Sunoco Motor Oil

Branch Offices and Warehouses

Akron	Boston	Cincinnati	Dayton	Indianapolis	Newark	Rochester
Albany	Bridgeport	Cleveland	Detroit	Jackson, Mich.	New York	Syracuse
Atlantic City	Buffalo	Columbus	Flint	Jacksonville	Pittsburgh	Toledo
Baltimore	Chicago	Dallas	Grand Rapids	Montreal	Providence	Toronto
Battle Creek						Tulsa

French Oil Mill Machinery C., Piqua, Ohio.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oilgear Co., Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.
West Tire Setter Co., Rochester, N. Y.

PRESSES, POWER FORCING

Atlas Press Co., Kalamazoo, Mich.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Lucas Machine Tool Co., Cleveland.
Southwark Foundry & Machine Co., Philadelphia.

PRESSES, ROLL AND DIAL FEED FOR

King, R. D., 1620 Monadnock Block, Chicago.
Littell Machine Co., F. J., 4125 Ravenswood Ave., Chicago.
S & S Machine Works, 4522 W. Lexington St., Chicago.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

PRESSES, SCREW

Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgeton, N. J.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.
Niagara Machine & Tool Works, Buffalo, N. Y.
Shuster Co., F. B., New Haven, Conn.
Toledo Mch. & Tool Co., Toledo, O.

PRESSES, SHEET METAL WORKING

Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Ams, Max, Machine Co., 101 Park Ave., New York.
Automatic Mch. Co., Bridgeport, Conn.
Baird Mch. Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgeton, N. J.
King, R. D., 1620 Monadnock Block, Chicago.
Loshbough-Jordan Tool & Mch. Co., Elkhart, Ind.
Loy & Nawrath, Div., Birmingham Iron Foundry, Derby, Conn.
Niagara Machine & Tool Works, Buffalo, N. Y.
Southwark Foundry & Machine Co., Philadelphia.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Machine & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

PRESSES, SHELL BANDING

Southwark Foundry & Machine Co., Philadelphia.
West Tire Setter Co., Rochester, N. Y.

PRESSES, STRAIGHTENING

Canedy-Otto Mfg. Co., Chicago Heights Ill.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Southwark Foundry & Machine Co., Philadelphia.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.
Watson-Stillman Co., 192 Fulton St., New York.

PRESSES, TRIMMING

Adriance Mch. Works, Inc., 78 Richards St., Brooklyn, N. Y.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mch. Co., Bridgeton, N. J.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.
Williams, White & Co., Moline, Ill.

PROFILING MACHINES

Automatic Mch. Co., Bridgeport, Conn.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Garvin Machine Co., Spring and Varick Sts., New York.
Leland-Gifford Co., Worcester, Mass.
Newton Machine Tool Works, Inc., Philadelphia.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., Worcester, Mass.
Wade-American Tool Co., Waltham, Mass.

PULLEYS

American Pulley Co., Philadelphia.
Brown Co., A. & F., 79 Barclay St., New York.
Cresson-Morris Co., Philadelphia.
Johnson Machine Co., Carlyle, Manchester, Conn.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Wood's Sons Co., T. B., Chambersburg, Pa.

PULLEYS, FRICTION

American Pulley Co., Philadelphia.
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Co., A. & F., 79 Barclay St., New York.
Conway Clutch Co., Cincinnati.
Cresson-Morris Co., Philadelphia.
Johnson Machine Co., Carlyle, Manchester, Conn.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Link-Belt Company, Chicago.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Sellers & Co., Inc., Wm., Philadelphia.
Wood's Sons Co., T. B., Chambersburg, Pa.

PULLEY TREADS

Smith & Serrel, Newark, N. J.

PULLEY TURNING AND BORING MACHINES

American Tool Works Co., Cincinnati.
LeBond, R. K., Machine Tool Co., Cincinnati.
Niles-Bement-Pond Co., 111 Broadway, New York.

PUMP LEATHERS

Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Leader-Trahern Co., Decatur, Ill.

PUMPS, HYDRAULIC

Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., Buffalo, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York.
Oilgear Co., Milwaukee, Wis.
Southwark Foundry & Machine Co., Philadelphia.
Watson-Stillman Co., 192 Fulton St., New York.

PUMPS, LUBRICANT AND OIL

Brown & Sharpe Mfg. Co., Providence, R. I.
Leader-Trahern Co., Decatur, Ill.

PUMPS, PNEUMATIC

Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.
Leader-Trahern Co., Decatur, Ill.

PUMPS, ROTARY

Leader-Trahern Co., Decatur, Ill.

PUMPS, STEAM

Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York.

PUMPS, TURBINE DRIVEN

Earle Gear & Mch. Co., 4707 Stenton Ave., Philadelphia.
Ingersoll-Rand Co., 11 Broadway, New York.

PUMPS, VACUUM

Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Ingersoll-Rand Co., 11 Broadway, New York.
Leiman Bros., 60-62 Lispenard St., New York.

PUNCHES, CENTERING

Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

PUNCHING MACHINERY

Buffalo Forge Co., Buffalo, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Ferracute Mch. Co., Bridgeton, N. J.
Hilles & Jones Works, Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Loshbough-Jordan Tool & Mch. Co., Elkhart, Ind.
Mitts & Merrill, 843 Water St., Saginaw, Mich.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Southwark Foundry & Machine Co., Philadelphia.
Union Mfg. Co., New Britain, Conn.
Watson-Stillman Co., 192 Fulton St., New York.
Wickes Bros., Saginaw, Mich.
Williams, White & Co., Moline, Ill.

PYROMETERS

American Gas Furnace Co., Elizabeth, N. J.
Bristol Co., Waterbury, Conn.
Hoskins Mfg. Co., Detroit, Mich.
Leeds & Northrup Co., Philadelphia.
Shore Instrument & Mfg. Co., Jamaica, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

RACK CUTTING MACHINES AND ATTACHMENTS

Adams Co., Dubuque, Iowa.
Gould & Eberhardt, Newark, N. J.
LeBlond Machine Tool Co., R. K., Cincinnati.

RACKS, CUT

Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Machine Co., Pittsburgh.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Mch. Co., 232 N. Curtis St., Chicago.
Horsburgh & Scott Co., Cleveland.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Newark Gear Cutting Machine Co., Newark, N. J.
Nuttall Co., R. D., Pittsburgh.
Philadelphia Gear Works, Philadelphia.
Simonds Mfg. Co., Fitchburgh, Pa.
Stahl Gear & Mch. Co., Cleveland.

RACKS, STOCK, TOOL AND PATTERN

Brown Engineering Co., 133 N. 3rd St., Reading, Pa.
Western Tool & Mfg. Co., Springfield, Ohio.

RACKS, TOOL

See Racks, Stock, Tool and Pattern.

RADIATORS, JAPANNING OVEN

American Gas Furnace Co., Elizabeth, N. J.

REAMER HOLDERS, FLOATING

Scully-Jones & Co., 13th and Robey Sts., Chicago.

REAMERS

Brown & Sharpe Mfg. Co., Providence, R. I.
Brubaker & Bros., Co., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland.
Columbus Die, Tool & Mch. Co., Columbus, O.
Detroit Twist Drill Co., Detroit.
Gammons-Holman Co., Manchester, Conn.
Goddard & Goddard Co., Detroit.
Greenfield Tap & Die Corp., Greenfield, Mass.
McCrosky Tool Corp., Meadville, Pa.
Millersburg Reamer & Tool Co., Millersburg, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit.
Pratt & Whitney Co., Hartford, Conn.
Schellenbach-Hunt Tool Co., Cincinnati.
Standard Tool Co., Cleveland.
Whitman & Barnes Mfg. Co., Akron, Ohio.

REAMERS, ADJUSTABLE

Cleveland Twist Drill Co., Cleveland.
Detroit Twist Drill Co., Detroit.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Greenfield Tap & Die Corp., Greenfield, Mass.
McCrosky Tool Corp., Meadville, Pa.
Millersburg Reamer & Tool Co., Millersburg, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Schellenbach-Hunt Tool Co., Cincinnati.
Wetmore Reamer Co., Milwaukee, Wis.
Whitman & Barnes Mfg. Co., Akron, Ohio.

REAMERS, PORTABLE ELECTRIC

Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
United States Electrical Tool Co., Cincinnati.
Van Dorn Electric Tool Co., Cleveland.

REAMERS, TAPER PIN HOLE

Gammons-Holman Co., Manchester, Ct.
Greenfield Tap & Die Corp., Greenfield, Mass.
Pratt & Whitney Co., Hartford, Conn.
Whitman & Barnes Mfg. Co., Akron, Ohio.

RECORDING INSTRUMENTS FOR ELECTRICITY

Bristol Co., Waterbury, Conn.
General Electric Co., Schenectady, N. Y.
Leeds & Northrup Co., Philadelphia.

RECORDING INSTRUMENTS FOR PRESSURE

Bristol Co., Waterbury, Conn.

RECORDING INSTRUMENTS FOR SPEED

Bristol Co., Waterbury, Conn.

RECORDING INSTRUMENTS FOR TEMPERATURE

American Gas Furnace Co., Elizabeth, N. J.
Bristol Co., Waterbury, Conn.
Leeds & Northrup Co., Philadelphia.

RECORDING INSTRUMENTS FOR TIME

Bristol Co., Waterbury, Conn.
Ferner Co., R. Y., Washington, D. C.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.

REELS FOR HOLDING STOCK

S. & S. Machine Works, 4522 West Lexington St., Chicago.

REGULATORS, PRESSURE

Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
General Electric Co., Schenectady, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

REGULATORS, TEMPERATURE

General Electric Co., Schenectady, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

RHEOSTATS

General Electric Co., Schenectady, N. Y.
Monitor Controller Co., Baltimore, Md.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

RIFLE BARREL MACHINERY

Baush Machine Tool Co., Springfield, Mass.
Diamond Mch. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.

RINGS, WELDLESS

Dyson & Sons, Joseph, Cleveland.
Johnson & Jennings Co., Addison Rd. and Lake Shore R. R. Tracks, Cleveland, O.
Machinery Forging Co., Cleveland.

RIVETERS, ELECTRIC

Winfied Electric Welding Mch. Co., Warren, O.

RIVETERS, HYDRAULIC

Bethlehem Steel Co., Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Oilgear Co., Milwaukee, Wis.
Southwark Foundry & Machine Co., Philadelphia.

RIVETERS, PNEUMATIC

Chicago Pneumatic Tool Co., 6 E. 44th St., New York.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Ingersoll-Rand Co., 11 Broadway, New York.
Southwark Foundry & Mch. Co., Philadelphia.

RIVETERS, STEAM

Hanna Engineering Works, 1763 Elston Ave., Chicago.

RIVETING MACHINES

Buffalo Forge Co., Buffalo, N. Y.
Grant Mfg. & Mch. Co., N. W., Station, Bridgeport, Conn.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
High Speed Hammer Co., Inc., Rochester, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Shuster Co., F. B., Mfg. Co., Hartford, Conn.
Townsend, H. P., Mfg. Co., Hartford, Conn.

RIVET SETS

Hunter Saw & Mch. Co., Pittsburgh.
Ingersoll-Rand Co., 11 Broadway, New York.
Williams, J. H., & Co., Buffalo, N. Y.

ROD CUTTERS, HAND POWER

Tucker, W. M. & C. F., Hartford, Conn.

ROD CUTTING MACHINES

Union Mfg. Co., New Britain, Conn.

ROLLING MACHINES, TAPERED FORGING

Ajax Mfg. Co., Cleveland.
Williams, White & Co., Moline, Ill.

ROLLING MILL MACHINERY

Ajax Mfg. Co., Cleveland.
Bethlehem Steel Co., Bethlehem, Pa.
Fawcus Machine Co., Pittsburgh.

ROPE DRESSING AND PRESERVATIVE

Link-Belt Company, Chicago.

ROPE DRIVES

Cresson-Morris Co., Philadelphia.
Link-Belt Company, Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

RULES, STEEL

Almond Mfg. Co., T. R., Ashburnham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.

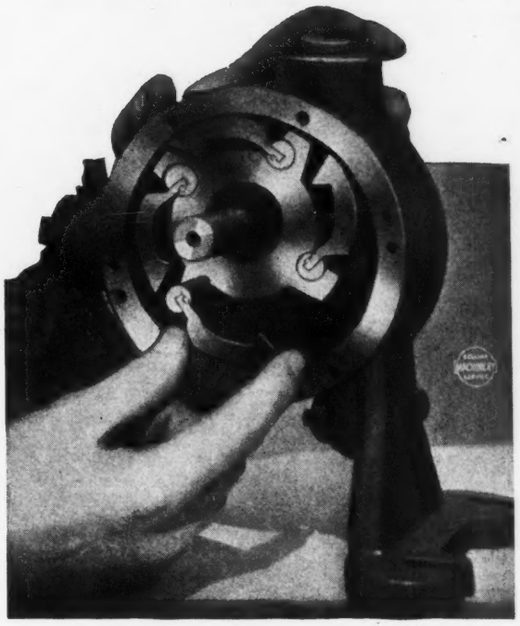
RUST PREVENTIVE

International Chemical Co., Philadelphia.
Oakley Chemical Co., 26 Thames St., New York.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

Does Your Blower Puff the Air?

Does it make a great Noise?



If it does either of these things then you are a logical prospective customer for

LEIMAN BROS.
ROTARY
POSITIVE
HIGH PRESSURE
(PATENTED)

AIR PUMPS

"They take up their own wear"

USED FOR

OPERATING GAS FURNACES AND BLOWPIPES
OIL FIRED FURNACES
FUEL OIL BURNING OUTFITS
AGITATING SOLUTIONS
AGITATING WATER FOR ICE MAKING
ATOMIZERS
GLASS BLOWING
SAND BLASTING
TESTING FOR LEAKS
PRESSING IRONS
BLOWING CHIPS AND STAMPINGS FROM PRESSES AND MACHINES
BLOWING DUST OUT OF MACHINERY

Also for VACUUM

FOR

FILLING BOTTLES
MILKING MACHINES
PAPER FEEDERS
VACUUM CLEANING
SUCTION CHUCKS
WRAPPING MACHINES
LABELLING
STEAM VACUUM HEATING

A SIZE FOR EVERY PURPOSE OR WE MAKE ONE TO FIT.

Most big users of air pumps use Leiman Bros. Air Pumps. They do the work well and are a recommendation in the sale of automatic machinery using air.

A free Trial to Automatic Machinery Manufacturers

LEIMAN BROS. 60 LISPENARD ST., NEW YORK

MAKERS OF GOOD MACHINERY FOR 35 YEARS

Compact—Sensitive—Accurate—Durable

The "ATLAS JUNIOR" INDICATOR

Reads over a range of 0.055"—at a glance. Dial may be set at zero after adjusting to work. Contact point can be locked in position for inspecting. Keep it in your pocket and use it anywhere. Details?

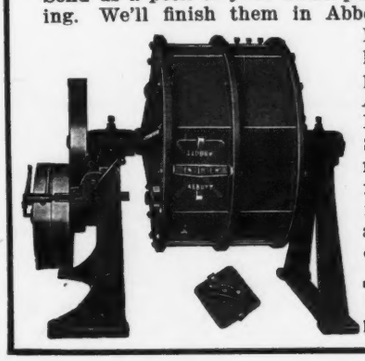
PRICE $7.50

Sold by Dealers or Direct

WALLACE BROS.
160 N. Wells St. CHICAGO, ILL.

Polishing Small Metal Parts?

Send us a peck of your small parts ready for polishing. We'll finish them in Abbott Ball Burnishing Barrels and promptly return them with production estimate. Abbott Burnishing Barrels with Abbott Special Balls are a most economical method of polishing: simple, easy and economical to operate. Details?



The Abbott Ball Co.
Elmwood, Hartford, Conn.

Is it Worth a Dime to Protect Your Hands from File Cuts?

Then send us ten cents for a sample Osgood's Safety "Filegrip," a soft pliable rubber guard that slips over the point of your file and prevents abrasions and cuts while filing.

Knowing that your file is safe, you can do more and better work.

Osgood's Safety Filegrip is listed by the Underwriter's Laboratories as standard accident prevention equipment—further evidence that it *protects*.

Send the dime now and get acquainted with a sample. Once tried, you'll never file without a "Filegrip."

J. L. OSGOOD TOOL COMPANY
43-45 Pearl Street Buffalo, N. Y.

SAFETY GUARDS FOR PUNCH PRESSES
Taylor-Shantz Co., Rochester, N. Y.
Wiesman Mfg. Co., Dayton, O.

SAND BLAST EQUIPMENT
Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
Ingersoll-Rand Co., 11 Broadway, New York.
Leiman Bros., 60-62 Lispenard St., New York.

SAW BLADES, CIRCULAR METAL CUTTING
Crescent Machine Co., 56 Main St., Leetonia, O.
Hunter Saw & Mch. Co., Pittsburgh.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Simonds Saw & Steel Co., Fitchburg, Mass.

SAW BLADES, HACK
American Saw & Mfg. Co., Springfield, Mass.
Barnes Co., W. O., Detroit.
Clemson Bros., Inc., Middletown, N. Y.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Millers Falls Co., Millers Falls, Mass.
Simonds Saw & Steel Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.
Victor Saw Works, Middletown, N. Y.

SAW BLADES, METAL CUTTING BAND
American Saw & Mfg. Co., Springfield, Mass.
Barnes Co., W. O., Detroit.
Huther Bros. Saw Mfg. Co., Inc., Rochester, N. Y.
Simonds Saw & Steel Co., Fitchburg, Mass.

SAW FRAMES, HACK
Clemson Bros., Inc., Middletown, N. Y.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Millers Falls Co., Millers Falls, Mass.
Simonds Saw & Steel Co., Fitchburg, Mass.
Starrett Co., L. S., Athol, Mass.
Victor Saw Works, Middletown, N. Y.

SAW SHARPENING MACHINES
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Hunter Saw & Mch. Co., Pittsburgh.

SAW TABLES
Baker Bros., Inc., Toledo, O.
Crescent Machine Co., 56 Main St., Leetonia, O.

SAWING MACHINES, CIRCULAR
Armstrong-Blum Mfg. Co., 343 N. Francisco Ave., Chicago.
Burr & Co., John T., Brooklyn, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia.
Espen-Lucas Machine Works, Philadelphia.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Newton Machine Tool Works, Inc., Philadelphia.
Vandyck-Churchill Co., 149 Broadway, New York.

SAWING MACHINES, FRICTION
Hunter Saw & Mch. Co., Pittsburgh.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

SAWING MACHINES, METAL CUTTING BAND
Ajax Mfg. Co., Cleveland, O.
Armstrong-Blum Mfg. Co., 343 No. Francisco Ave., Chicago.
Racine Tool & Machine Co., 250 15th St., Racine, Wis.

SAWING MACHINES, POWER HACK
Armstrong-Blum Mfg. Co., 343 No. Francisco Ave., Chicago.
Clemson Bros., Inc., Middletown, N. Y.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Millers Falls Co., Millers Falls, Mass.
Peerless Mch. Co., 1352 Clark St., Racine, Wis.
Racine Tool & Machine Co., 250 15th St., Racine, Wis.
Victor Saw Works, Middletown, N. Y.
Western Tool & Mfg. Co., Springfield, Ohio.

SAWING MACHINES, WOOD
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Crescent Machine Co., 56 Main St., Leetonia, O.
Woods Engineering Co., Alliance, O.

SAWS, SCREW SLOTTING
Barber-Colman Co., Rockford, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.

SCALES, COUNTING AND TESTING
Toledo Scale Co., Toledo, O.

SCALES, WEIGHING
Toledo Scale Co., Toledo, O.

SCRAPING TOOLS, METAL POWER DRIVEN
Anderson Bros. Mfg. Co., Rockford, Ill.

SCREENS, PERFORATED
Chicago Perforating Co., 2445 West 24th Place, Chicago.

SCREW CUTTING TOOLS
See Taps and Dies.

SCREW DRIVING MACHINES
Errington Mechanical Laboratory, Broadway and John St., New York.
Reynolds Machine Co., Massillon, O.

SCREW DRIVING MACHINE, MAGAZINE FEED
Reynolds Machine Co., Massillon, O.

SCREW MACHINES, AUTOMATIC
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland.
Cone Automatic Mch. Co., Inc., Windsor, Vt.
Davenport Machine Tool Co., Inc., Rochester, N. Y.
National Acme Co., Cleveland, O.
Townsend, H. P., Mfg. Co., Hartford, Conn.

SCREW MACHINES, HAND
See also Lathes, Turret.
Acme Machine Tool Co., Cincinnati.
Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence, R. I.
Dreses Machine Tool Co., Cincinnati.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
Kent-Owens Mch. Co., Toledo, O.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Stark Tool Co., Waltham, Mass.
Warner & Swasey Co., Cleveland.

SCREW MACHINES, MULTIPLE SPINDLE
Cleveland Automatic Machine Co., Cleveland.
Cone Automatic Machine Co., Inc., Windsor, Vt.
National Acme Co., Cleveland, O.

SCREW MACHINE TOOLS AND EQUIPMENT
Bardons & Oliver, Cleveland.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland.
Foster Machine Co., Elkhart, Ind.
Garvin Machine Co., Spring and Varick Sts., New York.
Jones & Lamson Machine Co., Springfield, Vt.
National Acme Co., Cleveland, O.
Potter & Johnston Machine Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Steinle Turret Machine Co., Madison, Wis.
Warner & Swasey Co., Cleveland.

SCREW MACHINE WORK
Albaugh-Dover Mfg. Co., 2100 Marshall Blvd., Chicago.
Eastern Machine Screw Corp., New Haven, Conn.
H. & G. Works, Eastern Mch. Screw Corp., New Haven, Conn.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
National Acme Co., Cleveland, O.
Poorman, J. E., Philadelphia.
Reliance Die & Stamping Co., 515 No. LaSalle St., Chicago.
Wicaco Screw & Mch. Works, Inc., Philadelphia.

SCREW PLATES
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Brubaker & Bros. Co., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hjorth Lathe & Tool Co., Boston.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.

SCREWS, CAP AND SET
Allen Mfg. Co., Hartford, Conn.
National Acme Co., Cleveland, O.
Poorman, J. E., Philadelphia.
Strong, Carlisle & Hammond Co., Cleveland.

SCREWS, MACHINE
Allen Mfg. Co., Hartford, Conn.
National Acme Co., Cleveland, O.
Poorman, J. E., Philadelphia.

SCREWS, SPECIAL LEAD, FEED, ETC.
Alling-Lander Co., Inc., Sodus, N. Y.
Automatic Mch. Co., Bridgeport, Conn.
Ferner Co., R. Y., Washington, D. C.
Hindley Gear Co., Philadelphia.

SEAMLESS STEEL TUBING
See Tubing, Steamless Steel.

SECOND-HAND MACHINERY, ETC.
Allen, H. F., Co., Inc., 30 Church St., New York.
Cincinnati Planer Co., Cincinnati.
Eastern Machinery Co., Cincinnati.
Essley Mchy. Co., E. L., 551-57 W. Washington Blvd., Chicago.
Hill, Clarke & Co., Inc., Boston.
Jones Mch. Tool Co., Cincinnati.
Kinsey Co., E. A., Cincinnati.
Lucas & Son, Inc., J. L., Bridgeport, Conn.
Lynd-Farquhar Co., Boston.
Miles Mchy. Co., Saginaw, Mich.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osborne & Sexton Mchy. Co., Columbus, O.
Oviatt, D. C., & Co., Cleveland.
Prentiss & Co., Inc., Henry, 149 Broadway, New York.
Reliance Machinery Sales Co., Pittsburg, Pa.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Vandyck Churchill Co., 149 Broadway, New York.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

SEPARATORS, CENTRIFUGAL
DeLaval Separator Co., 165 Broadway, New York.
Tolhurst Mch. Works, Troy, N. Y.

SEPARATORS, MAGNETIC
Magnetic Mfg. Co., Milwaukee, Wis.

SET SCREWS, SAFETY
Allen Mfg. Co., Hartford, Conn.
Bristol Co., Waterbury, Conn.
Strong, Carlisle & Hammond Co., Cleveland.

SHAFTING, STEEL
Adamson Mch. Co., Akron, O.
Brown Co., A. & F., 79 Barclay St., New York.
Moltrup Steel Products Co., Beaver Falls, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.

SHAFTING, STEEL TUBING FOR
National Tube Co., Pittsburgh.

SHAFTS, FLEXIBLE
Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago.
Errington Mechanical Laboratory, Broadway and John St., New York.
Haskins Co., R. G., 518½ W. Monroe St., Chicago.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Stow Mfg. Co., Binghamton, N. Y.
Strand & Co., N. A., 5001 N. Lincoln St., Chicago.

SHAFTS, HOLLOW BORED
American Hollow Boring Co., Erie, Pa.

SHAPERS
American Tool Works Co., Cincinnati.
Columbia Machine Tool Co., Hamilton, Ohio.
Gould & Eberhardt, Newark, N. J.
Hendey Mch. Co., Torrington, Conn.
Kelly Co., R. A., Xenia, O.
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., 111 Broadway, New York.
Osborne & Sexton Mch. Co., Columbus, O.
Potter & Johnston Machine Co., Pawtucket, R. I.
Rhodes Mfg. Co., Hartford, Conn.
Rockford Machine Tool Co., Rockford, Ill.
Smith & Mills Co., Cincinnati.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Steel Products Engineering Co., Springfield, O.
Walcott Lathe Co., Jackson, Mich.

SHAPER, PORTABLE
Reed-Prentice Co., Worcester, Mass.

SHAPERS, TRAVELING HEAD
Niles-Bement-Pond Co., 111 Broadway, New York.

SHAPERS, VERTICAL
Hanson-Whitney Machine Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rhodes Mfg. Co., Hartford, Conn.

SHEARING MACHINERY
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., Buffalo, N. Y.
Canton Foundry & Machine Co., Canton, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Consolidated Mch. Tool Corp. of America, 17 E. 42nd St., New York.
Ferracute Mch. Co., Bridgeton, N. J.
Hilles & Jones Works, Wilmington, Del.
Long & Allstatter Co., Hamilton, O.
Loy & Nawrath Div., Birmingham Iron Foundry, Derby, Conn.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Union Mfg. Co., New Britain, Conn.
Watson-Stillman Co., 192 Fulton St., New York.
Wickes Bros., Saginaw, Mich.
Williams, White & Co., Moline, Ill.

SHEARING MACHINERY, HAND POWER
Niagara Machine & Tool Works, Buffalo, N. Y.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Tucker, W. M. & C. F., Hartford, Conn.

SHEARS, ROTARY
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Machine & Tool Works, Buffalo, N. Y.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Southwark Foundry & Machine Co., Philadelphia.
Toledo Mch. & Tool Co., Toledo, O.

SHEARS, SQUARING
Loy & Nawrath, Div. Birmingham Iron Foundry, Derby, Conn.
Niagara Mch. & Tool Works, Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.

SHEAVE WHEELS
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Wood's Sons Co., T. B., Chambersburg, Pa.

SHEET METAL WORK
King, R. D., 1620 Monadnock Block, Chicago.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.

SHEET METAL WORKING MACHINERY
Adriance Machine Works, Inc., 78 Richards St., Brooklyn, N. Y.
Loy & Nawrath, Div. Birmingham Iron Foundry, Derby, Conn.
New Britain Machine Co., New Britain, Conn.
Niagara Machine & Tool Works, Buffalo, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.

SHERARDIZING, ELECTRIC
General Electric Co., Schenectady, N. Y.

SHIMS, LAMINATED
Laminated Shim Co., Inc., 221 14th St., Long Island City, N. Y.

SLEEVES
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.

SLIDE RESTS
Blount, J. G., Co., Central Ave., Everett, Mass.

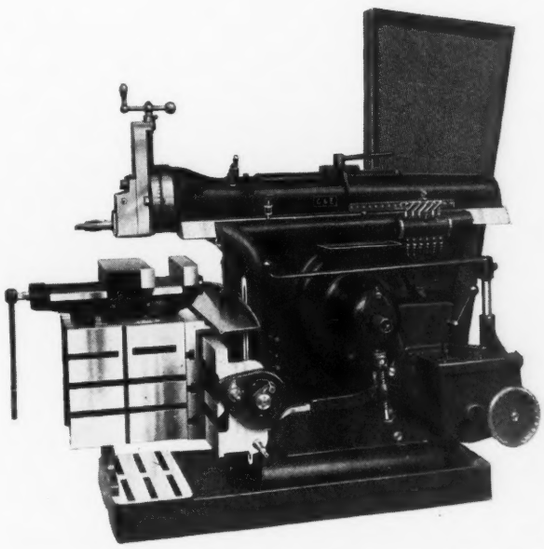
SLIDE RULES
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

G&E SHAPERS

"MORE · STROKES · PER · MINUTE"

The New Automatic Oiling System



You don't oil the new G & E Shaper with an oil can—you simply open up the oil reservoir for fifteen minutes in the morning, and again at noon—and ample lubricant flows to every bearing. There's no waste of oil—nor time. There's a sight feed drip to each tube and a separate tube to each bearing. Nothing to get out of order—impossible to overlook a bearing. This multiple Gravity Oiling System is only one of several original and improved features now being built into all G & E Shapers.

Let us tell you more about these machines

YOU SEE THEM EVERYWHERE

There's a New Bulletin, Send for a copy

GOULD & EBERHARDT
"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY
ESTABLISHED 1853 NEWARK, N.J. U.S.A. CHANCELLOR AVE.

Parts shown are approximately twice actual size.

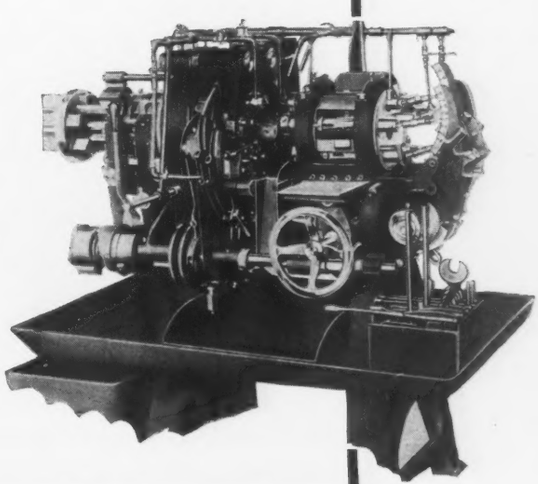
Send us your blueprints or sketches for a Davenport estimate on your work.

Speed? all you want of it

The Davenport Automatic cannot be overlooked if you are interested in speed in screw machine work.

This machine turns out screw machine parts at an almost incredible speed. A few pieces are shown as proof—one is turned out in 2 seconds, and another in 4 seconds, including slotting.

The Davenport is the five spindle type and besides maintaining a high rate of speed will hold to very close limits.



5 DAVENPORT
Spindle Automatic Screw Machine

DAVENPORT
MACHINE TOOL CO., Inc.
ROCHESTER, N. Y., U. S. A.

Represented by Motch & Merryweather Machy. Co., Cleveland, Cincinnati, Detroit, Pittsburgh. Henry Prentiss & Co., Inc., New York.

SLOTTERS, MACHINE
Baker Bros., Inc., Toledo, O.
Betts Machine Co., Rochester, N. Y.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.
Rhodes Mfg. Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia.

SLOTTERS, PORTABLE
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Newton Machine Tool Works, Inc., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

SOCKETS
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Akron, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

SOLDER
Hoyt Metal Co., St. Louis, Mo.

SPECIAL MACHINERY AND TOOLS
Adamson Mch. Co., Akron, O.
Air Reduction Sales Co., 342 Madison Ave., New York.
Automatic Machine Co., Bridgeport, Conn.
Baird Machine Co., Bridgeport, Conn.
Banner Die, Tool & Stamping Co., Columbus, O.
Bethlehem Steel Co., Bethlehem, Pa.
Betts Machine Co., Rochester, N. Y.
Bilgram Machine Works, 1231 Spring Garden St., Philadelphia.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Brock Tool & Mfg. Works, Arthur, Jr., Philadelphia.
Brown Co., A. & F., 79 Barclay St., New York.
Chambersburg Engineering Co., Chambersburg, Pa.
Columbus Die, Tool & Mch. Co., Columbus, O.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Davenport Mfg. Co., Meadville, Pa.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
Dupont Engineering Co., Wilmington, Del.
Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia.
Farrel Fdry. & Mch. Co., Inc., Buffalo, N. Y.
Fawcus Machine Co., Pittsburgh.
Ferner Co., R. Y., Washington, D. C.
Garvin Machine Co., Spring and Varick Sts., New York.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Grant Mfg. & Mch. Co., N. W., Station, Bridgeport, Conn.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kent-Owens Machine Co., Toledo, O.
King, R. D., 1620 Monadnock Block, Chicago.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Littell Machine Co., F. J., 4125 Ravenswood Ave., Chicago.
Lucas Machine Tool Co., Cleveland.
Manufacturers' Consulting Engineers, Syracuse, N. Y.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Meissalbach Catucci Mfg. Co., Newark, N. J.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Modern Tool Co., Erie, Pa.
Mueller Mch. Tool Co., Cincinnati.
National Acme Co., Cleveland, O.
National Automatic Tool Co., Richmond, Ind.
National Machinery Co., Tiffin, O.
National Tool Co., Cleveland.
National Twist Drill & Tool Co., Detroit, Mich.
Newton Machine Tool Works, Inc., Philadelphia.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles-Bement-Pond Co., 111 Broadway, New York.
Orrell, R. W., Mch. Co., Flint, Mich.
Paxson Co., J. W., Philadelphia.
Pratt & Whitney Co., Hartford, Conn.
Production Engineering Corp., Canastota, N. Y.
Reed-Prentice Co., Worcester, Mass.
Reliance Die & Stamping Co., 515 N. LaSalle St., Chicago.
Rockford Machine Tool Co., Rockford, Ill.
S & S Machine Works, 4522 West Lexington St., Chicago.
Shuster Co., F. B., New Haven, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Southwark Foundry & Machine Co., Philadelphia.
Steel Products Engineering Co., Springfield, O.
Sweet & Doyle Fdry. & Mch. Co., Troy, Green Island, N. Y.
Taylor-Shantz Co., Rochester, N. Y.
Toledo Mch. & Tool Co., Toledo, O.
V & O Press Co., Hudson, N. Y.
Wade-American Tool Co., Waltham, Mass.
Waltham Machine Works, Waltham, Mass.
Wicaco Screw & Mch. Wks., Inc., Philadelphia.
Woods Engineering Co., Alliance, O.

SPEED REDUCERS
Adamson Mch. Co., Akron, O.
Brown Co., A. & F., 79 Barclay St., New York.
Farrel Fdry. & Mch. Co., Inc., Buffalo, N. Y.
Foote Bros. Gear & Mch. Co., 232 North Curtis St., Chicago.
James Mfg. Co., D. O., 1114 West Monroe St., Chicago.
Jones Foundry & Machine Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Moore & White Co., 2707-2737 No. 15th St., Philadelphia.
Niles-Bement-Pond Co., 111 Broadway, New York.

SPINDLES, HOLLOW BORED
American Hollow Boring Co., Erie, Pa.

SPINNING LATHES
See Lathes, Spinning.

SPOT FACERS
Gairing Tool Co., Detroit.

SPRING COILING AND FORMING MACHINERY
Baird Machine Co., Bridgeport, Conn.
Hjorth Lathe & Tool Co., Boston.
Starn, H. M., Portage, O.

SPRINGS
Chatillon & Sons, John, 85 Cliff St., New York.

SPROCKET CHAINS
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Duckworth Chain & Mfg. Co., Springfield, Mass.
Link-Belt Company, Chicago.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.
Ramsey Chain Co., Inc., Albany, N. Y.
Whitney Mfg. Co., Hartford, Conn.

SPROCKETS
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Quincy, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago.
Duckworth Chain & Mfg. Co., Springfield, Mass.
Foote Bros. Gear & Mch. Co., 232 N. Curtis St., Chicago.
Jones Foundry & Mch. Co., W. A., 4409 W. Roosevelt Rd., Chicago.
Link-Belt Company, Chicago.
Mass. Gear & Tool Co., Woburn, Mass.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston 25, Mass.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Philadelphia.
Whitney Mfg. Co., Hartford, Conn.

SPRUE CUTTERS
Hanna Engineering Works, 1763 Elston Ave., Chicago.

STAMPINGS, SHEET METAL
Alemite Die-Casting & Mfg. Co., 2640-54 Belmont Ave., Chicago.
American Tool & Mfg. Co., Urbana, Ohio.
Banner Die, Tool & Stamping Co., Columbus, O.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.
King, R. D., 1620 Monadnock Block, Chicago.
Soss Mfg. Co., Brooklyn, N. Y.

STAMPS, STEEL AND MARKING DIES
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh.
Schoder & Lombard Stamp Co., 202 Centre St., New York.
Schwerdtle Stamp Co., Bridgeport, Ct.

STEEL
Central Steel Co., Massillon, O.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Hawkridge Bros. Co., Boston, Mass.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Simonds Saw & Steel Co., Fitchburg, Mass.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL, COLD DRAWN
Anchor Drawn Steel Co., Latrobe, Pa.
Moltrup Steel Products Co., Beaver Falls, Pa.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Union Drawn Steel Co., Beaver Falls, Pa.

STEEL, STRIP AND SHEET
Central Steel Co., Massillon, O.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

STEEL, HIGH SPEED TOOL
Anchor Drawn Steel Co., Latrobe, Pa.
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Hawkridge Bros. Co., Boston, Mass.
Haynes Stellite Co., 30 E. 42nd St., New York.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Simonds Saw & Steel Co., Fitchburg, Mass.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL, MACHINE
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Hawkridge Bros. Co., Boston, Mass.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Union Drawn Steel Co., Beaver Falls, Pa.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STELLITE
Haynes Stellite Co., 30 E. 42nd St., New York.

STENCILS, STEEL
Schoder & Lombard Stamp Co., 202 Centre St., New York.

STOCKS, DIE
Armstrong Mfg. Co., Bridgeport, Conn.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W. Div., Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Holland Mfg. Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, Inc., D., Yonkers, N. Y.

STONES, OIL
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.

STOOLS AND CHAIRS, STEEL
See Furniture, Shop and Drafting-room.

STRAIGHTENING MACHINERY
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Shuster Co., F. B., New Haven, Conn.
Springfield Machine Tool Co., 631 Southern Ave., Springfield, O.

STUD SETTERS, OPENING
Errington Mechanical Laboratory, Broadway and John St., New York.
Gaterman, W., Mfg. Co., Manitowoc, Wis.
Geometric Tool Co., New Haven, Conn.

SUB PRESSES
Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago.
Diamant Tool & Mfg. Co., Inc., Newark, N. J.
U. S. Tool Co., Inc., Newark, N. J.

SWAGING MACHINES
Etna Machine Co., Toledo, O.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Torrington Co., Torrington, Conn.

SWITCHBOARDS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

SWITCHES
Bristol Co., Waterbury, Conn.
General Electric Co., Schenectady, N. Y.
Monitor Controller Co., Baltimore, Md.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

TACHOMETERS
Bristol Co., Waterbury, Conn.
Coats Mch. Tool Co., Inc., 112 W. 40th St., New York.
Veeder Mfg. Co., 39 Sergeant St., Hartford, Conn.

TAPES, MEASURING
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.

TAP EXTENSIONS
Allen Mfg. Co., Hartford, Conn.

TAP EXTRACTORS
Walton Co., Hartford, Conn.

TAP HOLDERS
National Automatic Tool Co., Richmond, Ind.

TAPPING ATTACHMENTS AND DEVICES
American Tool Works Co., Cincinnati.
Baker Bros., Inc., Toledo, O.
Barber-Colman Co., Rockford, Ill.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati.
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Eastern Tube & Tool Co., Inc., Brooklyn, N. Y.
Errington Mechanical Laboratory, Broadway & John St., New York.
Gaterman, W., Mfg. Co., Manitowoc, Wis.
Geometric Tool Co., New Haven, Ct.
Leland-Gifford Co., Worcester, Mass.
Modern Tool Co., Erie, Pa.
Mueller Machine Tool Co., Cincinnati.
National Automatic Tool Co., Richmond, Ind.
Procunier, Wm. L., 18 So. Clinton St., Chicago.
Townsend, H. P., Mfg. Co., Hartford, Conn.
Western Mch. Tool Works, Holland, Mich.
Whitney Mfg. Co., Hartford, Conn.

TAPPING MACHINES
Acme Machinery Co., Cleveland.
Baker Bros., Inc., Toledo, O.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Burke Machine Tool Co., 516 Sandusky St., Conneaut, O.
Garvin Machine Co., Spring and Varick Sts., New York.
Gaterman, W., Mfg. Co., Manitowoc, Wis.
Geometric Tool Co., New Haven, Ct.
Langelier Mfg. Co., Arlington, Cranston, R. I.
Moline Tool Co., Moline, Ill.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
National Automatic Tool Co., Richmond, Ind.
National Machinery Co., Tiffin, O.
Procunier, Wm. L., 18 So. Clinton St., Chicago.
Rockford Drilling Mch. Co., Rockford, Ill.
Saunders' Sons, Inc., D., Yonkers, N. Y.

TAPS
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Brubaker & Bros., Co., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hanson Tap & Gage Co., Hartford, Conn.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago.
Landis Machine Co., Inc., Waynesboro, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland.
Pratt & Whitney Co., Hartford, Conn.
Saunders' Sons, Inc., D., Yonkers, N. Y.
Standard Tool Co., Cleveland.

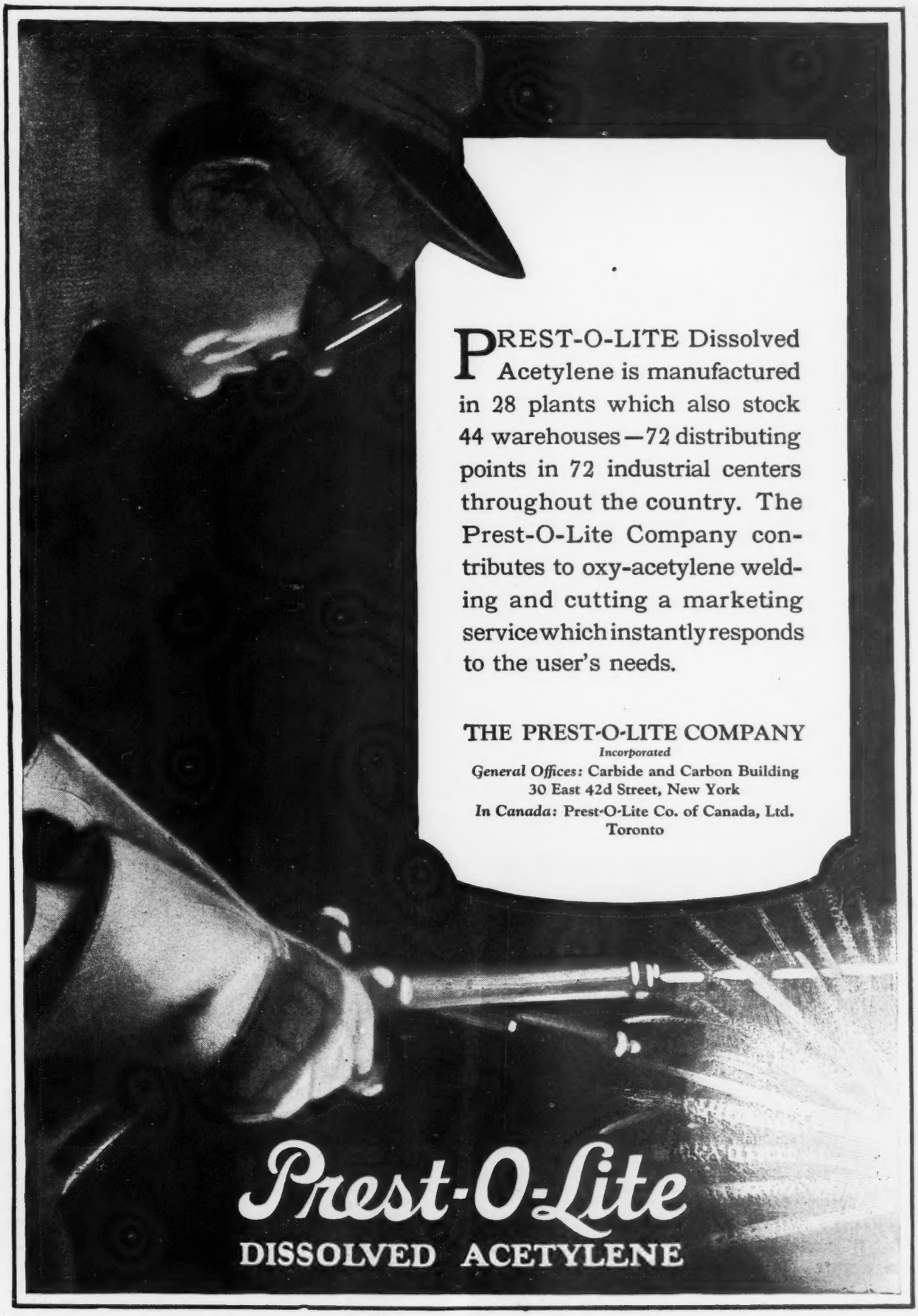
TAPS, COLLAPSING
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Errington Mechanical Laboratory, Broadway and John St., New York.
Geometric Tool Co., New Haven, Conn.
Modern Tool Co., Erie, Pa.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
National Acme Co., Cleveland, O.

THERMOMETERS
American Gas Furnace Co., Elizabeth, N. J.
Bristol Co., Waterbury, Conn.
Taylor Instrument Companies, Rochester, N. Y.

THERMOMETERS, INDICATING AND RECORDING
Taylor Instrument Companies, Rochester, N. Y.

THREAD CUTTING MACHINERY
Acme Machinery Co., Cleveland.
Automatic Mch. Co., Bridgeport, Conn.
Eastern Machine Screw Corp., New Haven, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Ferner Co., R. Y., Washington, D. C.
Geometric Tool Co., New Haven, Conn.
H & G Works, Eastern Machine Screw Corp., New Haven, Conn.
Landis Machine Co., Inc., Waynesboro, Pa.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
National Acme Co., Cleveland, O.
National Machinery Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Williams Tool Corp., Erie, Pa.

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268


PREST-O-LITE Dissolved Acetylene is manufactured in 28 plants which also stock 44 warehouses—72 distributing points in 72 industrial centers throughout the country. The Prest-O-Lite Company contributes to oxy-acetylene welding and cutting a marketing service which instantly responds to the user's needs.
THE PREST-O-LITE COMPANY
Incorporated
General Offices: Carbide and Carbon Building
30 East 42d Street, New York
In Canada: Prest-O-Lite Co. of Canada, Ltd.
Toronto
Prest-O-Lite
DISSOLVED ACETYLENE

THREAD CUTTING TOOLS
Armstrong Bros. Tool Co., 313 No. Francisco Ave., Chicago.
Ready Tool Co., Bridgeport, Conn.
Rivett Lathe & Grinder Corp., Brighton, Boston.
Williams, J. H., & Co., Buffalo, N. Y.

THREAD GAGES
See Gages, Thread.

THREAD MILLING MACHINES
Consolidated Mch. Tool Corp. of America, Wilmington, Del.
Hall Planetary Thread Milling Mch. Co., Philadelphia.
Hanson-Whitney Machine Co., Hartford, Conn.
Newton Machine Tool Works, Inc., Philadelphia.
Pratt & Whitney Co., Hartford, Conn.
Smalley-General Co., Inc., Bay City, Mich.
Waltham Machine Works, Waltham, Mass.

THREAD ROLLING MACHINES
National Machinery Co., Tiffin, O.

THREAD ROLLING MACHINES, SHEET METAL
V & O Press Co., Hudson, N. Y.

TIME RECORDERS, WORKMEN'S TIME ON THE JOB
See Recording Instruments for Time.

TIRE MOLD CUTTING MACHINES
Keller Mechanical Engineering Corp., 74 Washington St., Brooklyn, N. Y.

TIRE WELDERS AND BENDERS
Williams, White & Co., Moline, Ill.

TOOL CASES
Gerstner & Sons, H., Dayton, O.
Starrett Co., L. S., Athol, Mass.

TOOL HOLDER BITS, HIGH SPEED STEEL
Armstrong Bros. Tool Co., 313 No. Francisco Ave., Chicago.
Barber-Colman Co., Rockford, Ill.
Colonial Steel Co., Pittsburgh.
Firth-Sterling Steel Co., McKeesport, Pa.
Simonds Saw & Steel Co., Fitchburg, Mass.
Vanadium-Alloys Steel Co., Latrobe, Pa.
Whitman & Barnes Mfg. Co., Akron,
Williams, J. H., & Co., Buffalo, N. Y.

TOOL HOLDERS
Armstrong Bros. Tool Co., 313 No. Francisco Ave., Chicago.
Cleveland Twist Drill Co., Cleveland.
Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
O. K. Tool Holder Co., Shelton, Ct.
Osgood Tool Co., J. L., Buffalo, N. Y.
Ready Tool Co., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams, J. H., & Co., Buffalo, N. Y.

TORCHES, OXY-ACETYLENE AND OXY-HYDROGEN
See Welding and Cutting, Oxy-Acetylene Equipment.

TRACING CLOTH AND PAPER
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.

TRACING FILING CABINETS
See Cabinets, Filing.

TRACKS, TROLLEY AND OVERHEAD
Harrington Co., Philadelphia.

TRACTORS, INDUSTRIAL
Elwell-Parker Electric Co., Cleveland.

TRAILERS, INDUSTRIAL
Elwell-Parker Electric Co., Cleveland.

TRANSFORMERS
General Electric Co., Schenectady, N. Y.
Reliance Elec. & Eng. Co., 1056 Ivanhoe Rd., Cleveland.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

TRANSITS, ENGINEERS
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago.
Keuffel & Esser Co., Hoboken, N. J.

TRANSMISSION MACHINERY
See Hangers, Shafting, Pulleys, Clutches, Couplings, Belting, Chain, etc.

TRANSMISSION, VARIABLE SPEED
Oilgear Co., Milwaukee, Wis.
Reeves Pulley Co., Columbus, Ind.

TROLLEYS AND TRAMWAYS
Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo.
Hanna Engineering Works, 1763 Elston Ave., Chicago.
Roeper Crane & Hoist Works, Reading, Pa.
Whiting Corp., Harvey, Ill.

TRUCKS, INDUSTRIAL
Elwell-Parker Electric Co., Cleveland.

TRUCK WHEELS
Divine Bros. Co., Utica, N. Y.

TUBE EXPANDERS
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Watson-Stillman Co., 192 Fulton St., New York.

TUBING, FLEXIBLE
Almond Mfg. Co., T. R., Ashburnham, Mass.

TUBING, SEAMLESS STEEL
National Tube Co., Pittsburgh.

TUBING, STEEL
National Tube Co., Pittsburgh.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

TUMBLING BARRELS
Abbott Ball Co., Elmwood, Hartford, Conn.
Baird Mch. Co., Bridgeport, Conn.
Globe Mch. & Stamping Co., 1255 W. 76th St., Cleveland, O.
Whiting Corp., Harvey, Ill.

TURBINES, STEAM
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York.
Southwark Fdry. & Mch. Co., Philadelphia.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Whiton, D. E., Mch. Co., New London, Conn.

TURNTABLES
Canton Fdry. & Mchy. Co., Canton, O.
Link-Belt Company, Chicago.
Whiting Corp., Harvey, Ill.

TURRET ATTACHMENTS
Almond Mfg. Co., T. R., Ashburnham, Mass.
McCrosky Tool Corp., Meadville, Pa.
Meisselbach-Catucci Mfg. Co., Newark, N. J.

TURRET LATHES, VERTICAL
Bullard Machine Tool Co., Bridgeport, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.

TWIST DRILLS
See Drills, Twist.

UNIONS
Dart Mfg. Co., E. M., Providence, R. I.

UNIVERSAL JOINTS
Baush Machine Tool Co., Springfield, Mass.
Boston Gear Works, Norfolk Downs, Quincy, Mass.

VALVE LEATHERS
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.

VALVES, HYDRAULIC
Elmes Engineering Works, Charles F., 222 North Morgan St., Chicago.
Watson-Stillman Co., 192 Fulton St., New York.

VENTILATING APPARATUS
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., Schenectady, N. Y.

VISE JAWS
Athol Machine & Fdry. Co., Athol, Mass.
Hollands Mfg. Co., Erie, Pa.

VISES AND CLAMPING DEVICES, AIR OPERATED
Logansport Mch. Co., 529 Market St., Logansport, Ind.

VISES, BENCH
Athol Machine & Fdry. Co., Athol, Mass.
Columbian Hardware Co., Cleveland.
Hollands Mfg. Co., Erie, Pa.
Reed Mfg. Co., Erie, Pa.
Western Tool & Mfg. Co., Springfield, Ohio.
Yost Mfg. Co., Meadville, Pa.

VISES, MACHINE
Armstrong Bros. Tool Co., 313 No. Francisco Ave., Chicago.
Athol Mch. & Foundry Co., Athol, Mass.
Barber-Colman Co., Rockford, Ill.
Brown Engineering Co., 133 No. Third St., Reading, Pa.
Graham Mfg. Co., Providence, R. I.
LeBlond, R. K., Machine Tool Co., Cincinnati.
Logansport Mch. Co., 529 Market St., Logansport, Ind.
Martin Tool & Die Works, J. E., Springfield, O.
Thomas Elevator Co., 24 So. Hoyne Ave., Chicago.
Whitney Mfg. Co., Hartford, Conn.
Yost Mfg. Co., Meadville, Pa.

VISES, PIPE
Armstrong Mfg. Co., Bridgeport, Conn.
Athol Mch. & Fdry. Co., Athol, Mass.
Bignall & Keeler Machine Works, Edwardsville, Ill.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Columbian Hardware Co., Cleveland.
Curtis & Curtis Co., 324 Garden St., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hollands Mfg. Co., Erie, Pa.
Reed Mfg. Co., Erie, Pa.
Saunders' Sons, Inc., D., Yonkers, N. Y.
Williams, J. H., & Co., Buffalo, N. Y.
Yost Mfg. Co., Meadville, Pa.

VISES, PLANER AND SHAPER
American Tool Works Co., Cincinnati.
Cincinnati Planer Co., Cincinnati.
Hendey Mch. Co., Torrington, Conn.

VISES, UNIVERSAL MACHINE
Barber-Colman Co., Rockford, Ill.
Boston Scale & Machine Co., Roxbury, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Engineering Co., 133 No. Third St., Reading, Pa.
Graham Mfg. Co., Providence, R. I.

VISES, UNIVERSAL WOODWORKERS'
Columbian Hardware Co., Cleveland.
Yost Mfg. Co., Meadville, Pa.

VOLTMETERS
Bristol Co., Waterbury, Conn.
General Electric Co., Schenectady, N. Y.

WASHER MACHINERY
National Machinery Co., Tiffin, O.

WASHERS
Globe Machine & Stamping Co., 1255 W. 76th St., Cleveland, O.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.
Wilmington Fibre Specialty Co., Wilmington, Del.

WASHERS, LEATHER
Chicago Belting Co., 127 N. Green St., Chicago, Ill.
Chicago Rawhide Mfg. Co., 1309 Elston Ave., Chicago.
Schieren Co., Charles A., 73 Ferry St., New York.

WASHERS, SPACING
See Collars, Spacing, etc.

WELDING AND CUTTING CASES
Air Reduction Sales Co., 342 Madison Ave., New York.
Linde Air Products Co., 30 E. 42nd St., New York.
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York.

WELDING AND CUTTING, JOB
Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
Electric Arc Cutting & Welding Co., Newark, N. J.
Globe Machine & Stamping Co., 1255 W. 76th St., Cleveland, O.
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York.
Thomson Electric Welding Co., Lynn, Mass.
Thomson Spot Welder Co., Lynn, Mass.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Winfield Electric Welding Mch. Co., Warren, O.

WELDING AND CUTTING, OXY-ACETYLENE EQUIPMENT
Air Reduction Sales Co., 342 Madison Ave., New York City.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.

WELDING EQUIPMENT, ELECTRIC ARC
Electric Arc Cutting & Welding Co., Newark, N. J.
General Electric Co., Schenectady, N. Y.
Gibb Instrument Co., Detroit.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

WELDING MACHINES, ELECTRIC BUTT
Federal Machine & Welder Co., Warren, O.
Gibb Instrument Co., Bay City, Mich.
Thomson Electric Welding Co., Lynn, Mass.
Winfield Electric Welding Mch. Co., Warren, O.

WELDING MACHINES, ELECTRIC SPOT
Acme Electric Welder Co., Los Angeles, Cal.
Federal Machine & Welder Co., Warren, O.
Gibb Instrument Co., Bay City, Mich.
Taylor Welder Co., Warren, O.
Thomson Electric Welding Co., Lynn, Mass.
Thomson Spot Welder Co., Lynn, Mass.
Winfield Electric Welding Mch. Co., Warren, O.

WELDING RODS AND WIRE
Air Reduction Sales Co., 342 Madison Ave., New York.
Davis-Bournonville Co. (Air Reduction Sales Co.), 342 Madison Ave., New York.
Electric Arc Cutting & Welding Co., Newark, N. J.

WIRE-NAIL MACHINERY
National Machinery Co., Tiffin, O.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago.

WIRE STRAIGHTENERS AND CUTTERS, AUTOMATIC
Shuster Co., F. B., New Haven, Conn.

WIRE WORKING MACHINERY
Baird Machine Co., Bridgeport, Conn.
King, R. D., 1620 Monadnock Block, Chicago.
Shuster Co., F. B., New Haven, Conn.

WOOD SCREW MACHINERY
Townsend, H. P., Mfg. Co., Hartford, Conn.

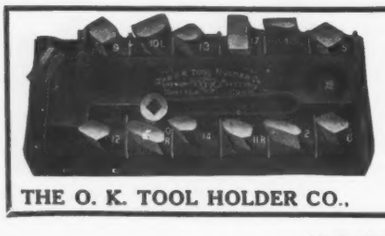
WOOD WORKING MACHINERY
Crescent Machine Co., 56 Main St., Leetonia, O.
Sidney Machine Tool Co., Sidney, O.

WRENCHES
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago.
Armstrong Mfg. Co., Bridgeport, Conn.
Athol Machine & Foundry Co., Athol, Mass.
Coes Wrench Co., Worcester, Mass.
Greene, Tweed & Co., 109 Duane St., New York.
Standard Tool Co., Cleveland.
Williams, J. H., & Co., Buffalo, N. Y.

WRENCHES, PIPE
Greene, Tweed & Co., 109 Duane St., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Reed Mfg. Co., Erie, Pa.
Williams, J. H., & Co., Buffalo, N. Y.

WRENCHES, RATCHET
Greene, Tweed & Co., 109 Duane St., New York.
Williams, J. H., & Co., Buffalo, N. Y.

WRENCHES, TAP
Besly & Co., Charles H., 120-B No. Clinton St., Chicago.
Brubaker & Bros. Co., W. L., 50 Church St., New York.
Butterfield & Co., Div. Union Twist Drill Co., Derby Line, Vt.
Card Mfg. Co., S. W., Div. of Union Twist Drill Co., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Starrett Co., L. S., Athol, Mass.



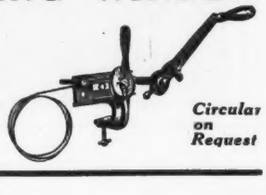
LATHE and PLANER TOOLS

THE O. K. TOOL HOLDER CO., SHELTON, CONN.

THE RAPID SPRING WINDER
(Patented)

Guaranteed to wind perfect, right or left hand extension or compression springs from 1/8" to 1 1/4" inside measurement, using any size wire up to 3/16". Price $6.00. A paying investment for tool-room.

H. M. STARN,
Portage, Ohio U. S. A.



Circular on Request

ALPHABETICAL INDEX OF ADVERTISERS, PAGES 267-268

Ideal Tool-room Equipment

Cataract Bench Lathes

The Cataract is more than a Bench Lathe—milling, turret and grinding attachments and double tool cross-slide see to that. You'll find it just what you want for small precision threading, boring, grinding and other operations. The range of Cataract Bench Lathes is realized by a visit to any of the many hundred plants where these machines are in constant use on countless varieties of work. In the above photograph, taken in the shops of the American High Speed Chain Company, at Indianapolis, the Cataract was drilling a tool steel die bushing; this machine performs a great variety of similar tool-room work.

May we send details? We'd like to tell you more about Cataract Bench Lathes

HARDINGE BROTHERS, Inc.

Berteau and Ravenswood Aves. **CHICAGO, ILL., U. S. A.**

EXCLUSIVE REPRESENTATIVES: Hill, Clarke & Co., Inc., Boston, Mass., Providence, R. I., New Haven, Conn. Hardinge Sales Co., Inc., Grand Central Palace, New York, N. Y. Swind Machinery Co. Philadelphia, Pa. E. C. Chapman, Rochester, N. Y. Hess-Schenck Co., Cleveland and Dayton, O. Coghlin-Kirkby Machinery & Supply Co., Toledo, Ohio; Cadillac Machinery Co., Detroit, Mich. Vonnegut Machinery Co., Indianapolis, Ind. Colcord-Wright Machinery & Supply Co., St. Louis, Mo. William K. Stamets, Pittsburgh, Pa. Smith-Booth-Usher Co., Los Angeles and San Francisco, Cal. CANADIAN REPRESENTATIVES: Arthur Jackson, Toronto, Ont. EUROPEAN REPRESENTATIVES: Alfred Herbert, Ltd.

McCrosky
COST-CUTTING TOOLS

Best for Babbitt

McCrosky-SUPER Adjustable Reamers

Incorporate two features necessary for successfully reaming Babbitt or similar white bearing metals—keen cutting blades and ample chip clearance. The installation view pictured above shows a McCrosky-SUPER Machine Reamer reaming Babbitt in an automobile plant that produces an American car long famous for its host of enthusiastic owners. The reamer is mounted in a floating holder and fitted with a pilot. It reams a crankshaft hole 1.744 in. in diameter, and 1½ in. deep, in the connecting rod and cap. The operator averages 65 pieces an hour. This particular McCrosky-SUPER Reamer has been in continuous use over three years. New sets of blades have been quickly and easily installed in original body, making reamer as good as new.

THE REASONS:—the design and material of McCrosky-SUPER blades make it easily possible to keep a keen cutting edge at all times. The exclusive McCrosky design for clearance (see cut below for relief of reamer body in front of cutting edge of blade) removes the possibility of chips clogging along the cutting edge of blades. These two features help to make McCrosky-SUPER Reamers standard tools wherever accurate and economical reaming is required.

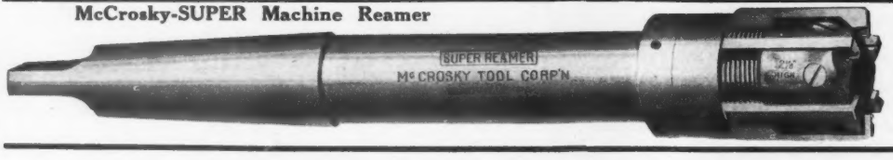
The latest McCrosky catalog will help you investigate the advantages of McCrosky-SUPER Reamers for your particular reaming job. Send for a copy today.

McCrosky Tool Corporation, Meadville, Pa., U.S.A.

Branches in Cleveland, Detroit, Chicago, San Francisco.
Agencies in all other principal cities

Exports Agents: Benjamin Whittaker, Inc., 21 State St., New York
Benjamin Whittaker, Ltd., 56 Ludgate Hill, London, E. C. 4.

McCrosky-SUPER Machine Reamer



Note relief of body for chip clearance—an exclusive McCrosky feature.

ALPHABETICAL INDEX OF ADVERTISERS

A

Abbott Ball Co. 192-259
Abrasive Company 104
Abrasive Machine Tool Co.....102
Acme Electric Welder Co.....165
Acme Machinery Co. 58
Acme Machine Tool Co.....137
Adams Co. 206
Adamson Mch. Co. 176
Adriance Machine Works, Inc....154
Air Reduction Sales Co.....165-166
Ajax Mfg. Co..... 93
Ajax Metal Co. 210
Albaugh-Dover Mfg. Co.....204
Alemite Die-Casting & Mfg. Co...177
Allen, H. F., Co., Inc.....235
Allen Mfg. Co. 247
Alling-Lander Co., Inc.....204
Almond, T. R., Mfg. Co.....222
American Broach & Machine Co., 146-156
American Crusher & Machinery Corp. 66
American Forge Co.....180
American Gas Furnace Co.....161
American Hollow Boring Co.....181
American Lead Pencil Co.....219
American Metal Treatment Co...164
American Pulley Co.....189
American Saw & Mfg. Co.....142
American Swiss File & Tool Co...227
American Tool & Mfg. Co.....174
American Tool Works Co.....14-15
Ames, B. C., Co..... 80
Ams, Max, Machine Co.....157
Anchor Drawn Steel Co.....238
Anderson Bros. Mfg. Co.....138-247
Arguto Oilless Bearing Co.....191
Armstrong-Blum Mfg. Co.....140
Armstrong Bros. Tool Co..... 65
Armstrong Mfg. Co.....148
Athol Mch. & Fdry. Co.....225
Atlantic Elevator Co., Inc.....208
Atlas Press Co. 150
Auburn Ball Bearing Co.....188
Automatic Buffing Mch. Co.....127
Automatic Machine Co.....255
Avey Drilling Machine Co.....118

B

Badger Tool Co.....113
Baird Machine Co.....156
Baker Brothers, Inc..... 72
Baldwin Chain & Mfg. Co.....190
Ball & Roller Bearing Co..... 41
Banner Die, Tool & Stamping Co..175
Bantam Ball Bearing Co.....191
Barber-Colman Co. 29-223
Bardons & Oliver 241
Barnes Drill Co., Inc.....123
Barnes, W. F., & John, Co..... 69
Barnes, W. O., Co., Inc.....141
Baush Machine Tool Co..... 10
Bearings Co. of America.....188
Beaudry Co., Inc.....154
Bennett Metal Treating Co.....164
Besly, Charles H., & Co.....125
Bethlehem Steel Co.....130
Betts Machine Works..... 67
Bignall & Keeler Mch. Works....149
Bilgram Machine Works.....204
Blanchard Machine Co.....102
Bliss, E. W., Company 151
Blount, J. G., Co.....110
Boker, H., & Co., Inc.....224
Boston Gear Works....191-207-229
Boston Scale & Machine Co.....227
Bowen Products Corp. 229
Bradford Machine Tool Co.....138
Bradley, C. C., & Son, Inc.....147
Breakstone, S. 188
Bridgeport Safety Emery Wheel Co., Inc. 111
Bristol Company....Inside front cover
Brock, Arthur, Jr., Tool & Mfg. Works 175
Brown, A. & F., Co.....206
Brown Engineering Co.....183
Brown & Sharpe Mfg. Co....85A-85B
Brubaker, W. L., & Bros. Co.....214
Bryant Chucking Grinder Co.....112
Buffalo Forge Co. 157
Builders Iron Foundry 255
Bullard Machine Tool Co..... 68
Bunting Brass & Bronze Co. 243
Burke Machine Tool Co.....134
Burr, John T., & Son.....184
Butterfield & Co., Div. Union Twist Drill Co. 253

C

Calder, Geo. H., Co.....110
Canedy-Otto Mfg. Co. 121
Canton Fdry. & Mch. Co.....193
Carborundum Company 106
Card, S. W., Mfg. Co., Div. of Union Twist Drill Co.....232
Carlyle Johnson Machine Co..... 30
Carpenter, J. M., Tap & Die Co...209
Carroll & Jamieson Mch. Tool Co..139
Carroll, A. V., Mch. Tool Co.....138
Central Steel Co. 212
Century Brass Works, Inc.....218
Century Electric Co. 172
Chambers, Bering, Quinlan Co....235
Chambersburg Engineering Co.....148
Champion Mch. & Forging Co....176
Champion Tool Works 135
Chatillon, John, & Sons.....226
Chicago Belting Company 183
Chicago Perforating Co. 142
Chicago Pneumatic Tool Co..... 57
Chicago Rawhide Mfg. Co. 196
Cincinnati Automatic Mch. Co...235
Cincinnati Bickford Tool Co...24-25
Cincinnati Gear Co. 206
Cincinnati Lathe & Tool Co.....255
Cincinnati Milling Machine Co.... 87
Cincinnati Planer Co. 133
Cisco Machine Tool Co.....255
Clark Cutter Co. 209
Classified Advertisements 239
Cleveland Armature Works, Inc..110
Cleveland Automatic Mch. Co.... 70
Cleveland Stone Co. 109
Cleveland Twist Drill Co.....60-61
Coats Machine Tool Co., Inc.....164
Coes Wrench Co. 227
Cogsdill Mfg. Co. 215
Colburn Mch. Tool Works..... 67
Colonial Steel Co. 79
Colton, Arthur, Co. 215
Columbia Machine Tool Co.....143
Columbian Hardware Co. 225
Columbus Die, Tool & Mch. Co...175
Cone Automatic Mch. Co., Inc...139
Connecticut Gears, Inc.....205
Consolidated Machine Tool Corp. of America 67
Conway Clutch Co. 184
Cooper Hewitt Electric Co..... 95
Cowles Tool Co.....208
Crescent Machine Co.....158
Cresson-Morris Co. 194
Crocker-Wheeler Co. 168
Cullman Wheel Co. 189
Curtis & Curtis Co. 149
Curtis Pneumatic Machinery Co...190
Cushman Chuck Co. 222

D

Danly Machine Specialties, Inc..175
Dart, E. M., Mfg. Co.....228
Davenport Machine Tool Co., Inc..261
Davenport Mfg. Co. 176
Davis-Bournonville Co. (Air Reduction Sales Co.) 165
Davis Keyseater Co. 158
Davis, Rodney 206
De Laval Separator Co. 131
Delta File Works 237
Desmond-Stephan Mfg. Co. 111
Detroit Stamping Co. 228
Detroit Twist Drill Co..... 20
Diamant Tool & Mfg. Co., Inc...181
Diamond Machine Co. 110
Diamond Saw & Stamping Works.142
Diefendorf Gear Corp. 206
Dietzgen, Eugene, Co.....218
Dixon, Joseph, Crucible Co..... 56
Divine Bros. Co. 103
Doehler Die-Casting Co. 179
Dreses Machine Tool Co.....116
Duckworth Chain & Mfg. Co.....186
DuPont Engineering Co. 176
Dyson, Joseph, & Sons.....181

E

Earle Gear & Machine Co...141-196
Eastern Machinery Co. 236
Eastern Machine Screw Corp.....245
Eastern Tube & Tool Co., Inc...220
Economy Drawing Table & Mfg. Co. 219
Edgemont Mch. Co. 189
Electric Arc Cutting & Welding Co. 164
Elgin Tool Works, Inc.....138
Elmes, Charles F., Engineering Works 156
Elwell-Parker Electric Co. 186
Errington Mechanical Laboratory..222
Espen-Lucas Machine Works....142
Essley, E. L., Machinery Co....234
Etna Machine Co.....146

F

Fafnir Bearing Co. .....Front cover
Farrel Fdry. & Mch. Co., Inc....205
Farrell-Cheek Steel Fdry. Co.....177
Fawcus Machine Co. 204
Federal Bearings Co., Inc.....193
Federal Machine & Welder Co....163
Federal Products Corp.....231
Fellows Gear Shaper Co. 40
Ferner, R. Y., Co.....231
Ferracute Machine Co. 150
Firth-Sterling Steel Co. 211
Fitchburg Machine Works 83
Flather Company 138
Foote Bros. Gear & Mch. Co.....201
Foote-Burt Company 71
Ford Chain Block Co. 192
Fosdick Machine Tool Co.....120
Foster Machine Co. 136
Francis & Company 110
Franklin Die-Casting Corp.....177
French Oil Mill Mchy. Co.....155
Frontier Chuck & Tool Co., Inc..220

G

Gairing Tool Co., Inc.....249
Gallmeyer & Livingston Co.....112
Gammons-Holman Co. 227
Ganschow, William, Co. 198
Gardner Machine Co.....107
Garvin Machine Co. 124
General Electric Co. 169
Geometric Tool Co. 62-64
Gerstner, H., & Sons.....218
Gibb Instrument Co. 164
Giddings & Lewis Mch. Tool Co.. 78
Gisholt Machine Co. 42-43
Gits Bros. Mfg. Co. 228
Gleason Works 202
Globe Machine & Stamping Co...159
Goddard & Goddard Co.....209
Gooley & Edlund, Inc.....134
Goss & de Leeuw Mch. Co. 135
Gould & Eberhardt 261
Goulds Mfg. Co. 229
Graham Mfg. Co. 113-225
Grant Gear Works 196
Grant Mfg. & Mch. Co. 121
Gray, G. A., Co..... 21
Greaves-Klusman Tool Co. 135
Greene, Tweed & Co.....226
Greenfield Tap & Die Corp.....110
Gwilliam Company 194

H

Hall Planetary Thread Milling Mch. Co., Inc. 132
Hanna Engineering Works.....192
Hanson Tap & Gauge Co..... 45
Hanson-Whitney Machine Co..... 44
Hardinge Bros., Inc. 265
Harrington Co. 123
Harvard Electric Co. 236
Haskins, R. G., Company 165
Hawkridge Bros. Co. 76-77
Hay Fdry. & Iron Wks.....236
Haynes Stellite Co. 74
Heald Machine Co. 38
Heim Grinder Co. 82
Helburn Thompson Co.....236
Hendey Machine Co. 241
Herbert, Alfred, Ltd. 239
Hetherington Co. 110
Hider Steel Ball Works.....186
High Speed Hammer Co., Inc.... 51
Hill, Clarke & Co., Inc. (Boston) .235
Hilles & Jones Works..... 67
Hilliard Clutch & Mchy. Co.....194
Hindley Gear Co. 204-231
Hjorth Lathe & Tool Co.....184
Hoefer Mfg. Co. 122
Hoggson & Pettis Mfg. Co.....223
Hollands Mfg. Co. 224
Hoover Steel Ball Co.....188
Horsburgh & Scott Co.....200
Hoskins Mfg. Co....Inside back cover
Hoyt Metal Co. 181
Hunter Saw & Machine Co.....141
Hurlbut, Rogers Mchy. Co.....148
Huther Bros. Saw Mfg. Co., Inc..142
Hyatt Roller Bearing Co..... 37

I

Industrial Press 96-126-160-230
Ingersoll Milling Machine Co..... 22
Ingersoll-Rand Co. 115
International Chemical Co. 216
International Machine Tool Co.... 35

J

Jacobs Mfg. Co. 39
James, D. O., Mfg. Co.....195
Johnson, Carlyle Machine Co..... 30
Johnston & Jennings Co., Inc...178
Jones & Lamson Mch. Co...16-17-64
Jones, W. A., Fdry. & Mch. Co...203
Jones Mch. Tool Co.....235

K

Kasenit Co. 165
Kearney & Trecker Corp..... 19
Keller Mechanical Engineering Corp. 181
Kelly, R. A., Company 143
Kent-Owens Machine Co.....178
Keuffel & Esser Co.....219
King, R. D. 150
Kingsbury Mfg. Co. 159
Kinsey, E. A., Company 234
Knight, W. B., Machinery Co....132
Kremer-Cummins Mch. Co.....189

L

Laminated Shim Co., Inc.....184
Landis Machine Co., Inc.....5-13
Landis Tool Co. 105
Langelier Mfg. Co. 158
Lapointe, J. N., Co. 113
Lapointe Mch. Tool Co.....119
Leader-Trahern Co. 97
LeBlond, R. K., Mch. Tool Co.... 23
Leeds & Northrup Co.....100
Lehmann Machine Co.....138
Leiman Bros. 259
Leland-Gifford Co. 4
Liberty Machine Tool Co.....134
Linde Air Products Co. 84
Link-Belt Company .....Back cover
Littell, F. J., Machine Co.....154
Littlejohn, A. J. 166
Lodge & Shipley Mch. Tool Co.... 8-9
Logansport Machine Co.....225
Long & Allstatter Co. 148
Loshbough-Jordan Tool & Mch. Co..152
Lovejoy Tool Co., Inc.....226
Lowe, H. A. 238
Loy & Nawrath Division, Birmingham Iron Foundry 148
Lucas, J. L., & Son, Inc.....236
Lucas Machine Tool Co..... 89
Luma Electric Equipment Co....165
Lynd-Farquhar Co. 235

M

Machine Products Co. 205
Machinery 96-126-160-230
Machinery Forging Co.....181
Madison Mfg. Co. 226
Magnetic Mfg. Co. 194
Manufacturers' Consulting Engineers 176
Marathon Electric Mfg. Co. 172
Marlin-Rockwell Corp. 183
Marquette Tool & Mfg. Co.....154
Marschke Mfg. Co. 112
Martin, J. E., Tool & Die Works..224
Massachusetts Gear & Tool Co....204
Master Electric Co. 167
McCrosky Tool Corp 266
McGill Metal Co.....176
Meachem Gear Corp.....251
Mehl Mch. Tool & Die Co.....175
Meisel Press Mfg. Co. 204
Meisselbach-Catucci Mfg. Co.....196
Merrell Mfg. Co. 148
Miles Machinery Co. 235
Millersburg Reamer & Tool Co., Inc..232
Millers Falls Co. 128
Miner & Peck Mfg. Co.....157
Minster Machine Co. 117
Mitchell Engineering Co.....253
Mitts & Merrill 63
Modern Tool Works 67
Moline Tool Co. 122
Moltrup Steel Products Co. 210
Monarch Machine Tool Co.....137
Monitor Controller Co.....170
Moore & White Co. 188
Morris Machine Tool Co.....120
Morse Chain Co. 185
Morse Twist Drill & Machine Co.. 33
Morton Mfg. Co. 135
Mt. Vernon Die Casting Corp....177
Muehlmatt, Adolph 122
Mueller Machine Tool Co.....234
Mummert-Dixon Co. 220
Murchey Mch. & Tool Co..... 50

ALPHABETICAL INDEX OF ADVERTISERS

N

National Acme Co. 54
National Automatic Tool Co. 36
National Machinery Co. 28
National Tool Co. 209
National Tube Co. 31
National Twist Drill & Tool Co. ..52
Nazel Engineering & Machine Wks. .146
Neil & Smith Electric Tool Co. ..167
Newark Gear Cutting Mch. Co. ..199
New Departure Mfg. Co. 55
Newton Mch. Tool Works. 67
Niagara Mch. & Tool Works. 153
Nicholson, W. H., & Co. 232
Nicholson File Co. 34
Niles-Bement-Pond Co. 6-7
Noble & Westbrook Mfg. Co. 167
Norma Company of America. 193
Norton Company 108
Nuttall, R. D., Co. 207

O

Oakley Chemical Co. 47
Oesterlein Machine Co. 133
Oilgear Co. 158
O. K. Tool Holder Co. 264
Oliver Instrument Co. 122-255
Orrell, R. W., Mch. Co. 174
Osborne & Sexton Mchy. Co. 235
Osgood, J. L., Tool Co. 259
Oviatt, D. C., & Co. 236

P

Paragon Machine Co. 218
Parker, C. L. 239
Parker-Kalon Corp. 94
Pawling & Harnischfeger Co. ...184
Paxson, J. W., Co. 174
Pedrick Tool & Mch. Co. 158
Peerless Machine Co. 129
Perkins Appliance Co. 196
Philadelphia Gear Works 197
Phoenix Die Casting Co. 178
Poole Engineering & Machine Co. .205
Poorman, J. E. 174
Potter & Johnston Machine Co. .. 18
Pratt & Whitney Co. 6-7
Prentiss, Henry, & Co., Inc. 234
Prest-O-Lite Co., Inc. 263
Procunier, William L. 222
Production Engineering Corp. 220
Production Machine Co. 111
Products Mfg. & Sales Co. 101

R

Racine Tool & Machine Co. 141
Ramsey Chain Co., Inc. 182
Ransom Mfg. Co. 113
Ready Tool Co. 237
Reed, Francis, Co. 122
Reed Mfg. Co. 224
Reed-Prentice Co. 32
Reeves Pulley Co. 182
Reliance Die & Stamping Co. ..174
Reliance Electric & Engineering Co. 172
Reliance Machinery Sales Co. 235
Republic Die Casting Co., Inc. ..178
Reynolds Machine Co. 253
Rhodes Mfg. Co. 143
Rivett Lathe & Grinder Corp. ..208
Rockford Drilling Machine Co. ..118
Rockford Lathe & Drill Co. 135
Rockford Machine Tool Co. 144
Rockford Milling Machine Co. 98
Rockford Tool Co. 99
Roeper Crane & Hoist Works. 191
Root Company 239
Rowbottom Machine Co. 114
Ryerson, Joseph T., & Son, Inc. . 81

S

S & S Machine Works. 156
Saunders', D., Sons, Inc. 148
Schatz Mfg. Co. 194
Schellenbach-Hunt Tool Co. 231
Schieren, Charles A., Co. 48
Schoder & Lombard Stamp Co. 231
Schwerdtle Stamp Co. 210
Scully-Jones & Co. 224
Sebastian Lathe Co. 139
Sellers, Wm., & Co., Inc. 116
Seneca Falls Machine Co. 75
Shore Instrument & Mfg. Co. 165
Shuster, F. B., Co. 253
Sibley Machine Co. 122
Sigourney Tool Co. 120
Simonds Mfg. Co. 206
Simonds Saw & Steel Company, Inside front cover
Sipp Machine Co. 118
S K F Industries, Inc. 12
Skayef Ball Bearing Co. 12
Slocomb, J. T., Co. 216
Smalley-General Co. 134
Smith & Mills Co. 142
Smith & Serrell. 182
Snyder, J. E., & Son Co. 247
Sommer & Adams Co. 209
Sess Mfg. Co. 177
South Bend Lathe Works. 138
Southwark Fdry. & Mch. Co. 155
Special Equipment Section. . .173-181
Springfield Machine Tool Co. 53
Stahl Gear & Machine Co. 205
Standard Tool Co. 49
Stark Tool Co. 134
Starn, H. M. 264
Starrett, L. S., Co. 217
Steel Products Engineering Co. 144
Steinle Turret Machine Co. 139
Sterling Die Casting Co., Inc. 178
Sterling Grinding Wheel Co. 109
Stow Mfg. Co., Inc. 167
Strand, N. A., & Co. 172
Strom Ball Bearing Mfg. Co. 59
Strong, Carlisle & Hammond Co., 164-237
Sun Oil Company 257
Superior Die Casting Co. 177
Surface Combustion Company ...164
Sweet & Doyle Fdry. & Mch. Co. .181

T

Taylor & Fenn Company 112
Taylor Instrument Companies. 167
Taylor-Shantz Co. 156
Taylor Welder Co. 162
Terkelsen Machine Co. 222
Thomas Elevator Co. 223
Thompson Grinder Co. 110
Thompson Electric Welding Co. 162
Thomson Spot Welder Co. 162
Timken Roller Bearing Co. 26-27
Toledo Machine & Tool Co. 150
Toledo Scale Co. 238
Tolhurst Machine Works. 158
Torrington Company 145
Townsend, H. P., Mfg. Co. 118
Tucker, W. M. & C. F. 158-255

U

Underwood, H. B., Corp. 228
Union Drawn Steel Co. 213
Union Mfg. Co. 220
Union Twist Drill Co. 210
United States Drill Head Co. 119
United States Electrical Tool Co. .172
United States Machine Tool Co. ..134
Universal Drafting Machine Co. 219
U. S. Tool Co., Inc. 174

V

V & O Press Co. 156
Vanadium Alloys Steel Co. 92
Van Dorn & Dutton Co. ...Insert 68A
Van Dorn Electric Tool Co., Insert 68B
Vandyck Churchill Co. 141
Veeder Mfg. Co. 238
Victor Saw Works 140
Vulcan Crucible Steel Co. 46

W

Wade-American Tool Co. 255
Walcott Lathe Co. 136
Walker, O. S., Co., Inc. 221
Wallace Bros. 259
Waltham Machine Works. 208
Walton Company 230
Want Advertisements 239
Warner & Swasey Co. 73
Waterston, J. M. 208
Watson-Stillman Co. 155
Watts Bros. Tool Works. 230
Westcott Chuck Co. 223
Western Mch. Tool Works. 118
Western Tool & Mfg. Co. 226
Westinghouse Electric & Mfg. Co. .171
Wetmore Reamer Co. 91
Wheel Trueing Tool Co. 111
Whiting Corporation 189
Whitman & Barnes Mfg. Co., Insert 36-A
Whitney Mfg. Co. 187
Whiton, D. E., Machine Co. 113
Wicaco Screw & Mch. Works, Inc. .174
Wickes Brothers 218
Wiesman Mfg. Co. 155
Willard Machine Tool Co. 139
Williams, I. B., & Sons. 186
Williams, J. H., & Co. 225
Williams Tool Corp. 148
Williams, White & Co. 157
Wilmarth & Morman Co. 253
Wilmington Fibre Specialty Co. ..210
Winfield Electric Welding Mch. Co. 165
Wisconsin Electric Co. 11
Woods Engineering Co. 111
Wood's, T. B., Sons Co. 192
Woodward & Powell Planer Co. ...134

Y

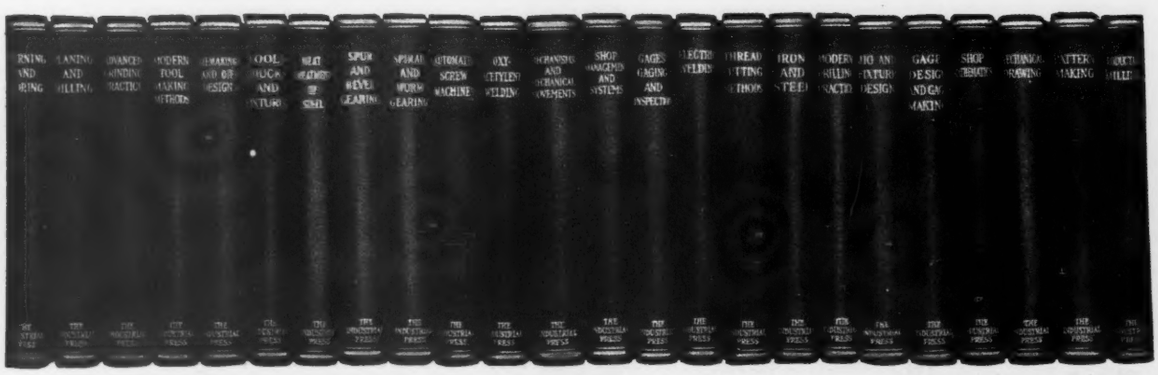
Yost Mfg. Co. 225

MACHINERY'S BOOKS

For Shop Superintendents, Foremen, Designers, Engineers, Draftsmen, Inspectors, Toolmakers, Machinists

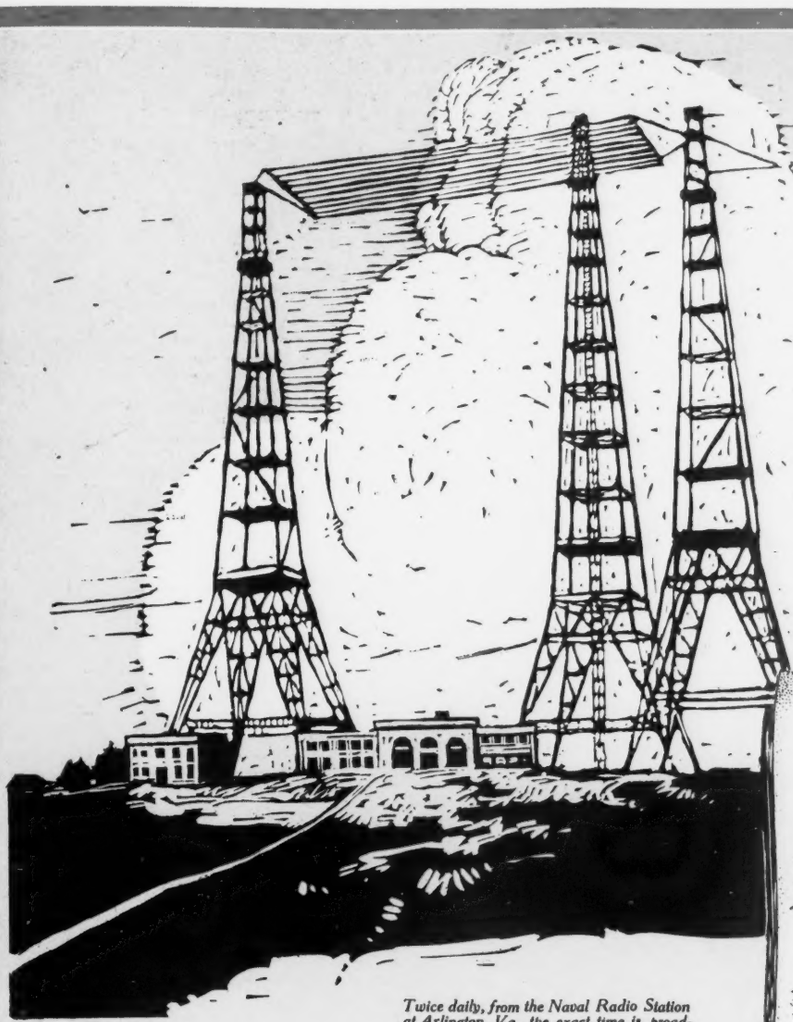
These twenty-four books constitute a very complete library for the mechanical executive. They are thoroughly practical, fully illustrated, durably bound, typical MACHINERY Books—packed full of solid, useful information.

$3.00 each. Special group prices—send for Bulletin.

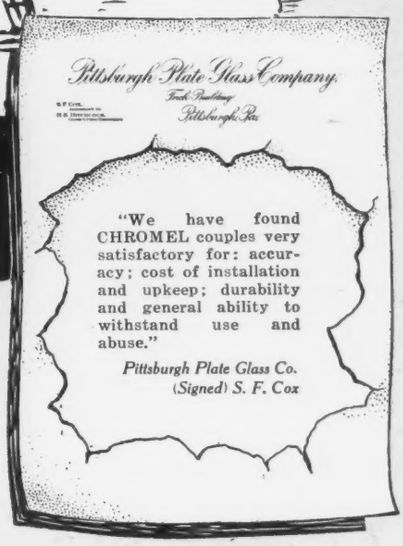


Self-Examination Sheet in Every Book

MACHINERY, 140-148 Lafayette Street, New York City



Twice daily, from the Naval Radio Station at Arlington, Va., the exact time is broadcasted. These signals are recorded on a chronograph at the Naval Observatory, and compared with the time-beats of a standard Master Clock.


Pittsburgh Plate Glass Company
Pittsburgh, Pa.
"We have found CHROMEL couples very satisfactory for: accuracy; cost of installation and upkeep; durability and general ability to withstand use and abuse."
Pittsburgh Plate Glass Co.
(Signed) S. F. Cox

Broadcasting Accuracy

Just as the Naval Radio Station broadcasts the exact time, so also, are Hoskins-Chromel Thermo-couples broadcasting accurate temperature measurements—all over the country, every day.

Whatever refinement of measurement the meter, itself, is capable of indicating, is matched by the accuracy of CHROMEL couples. And whatever the make of the meter, it may be used with these couples. CHROMEL couples are used not only with Hoskins Pyrometers, but on a large number of installations of all the other makes of instruments. The General Motors Corp., for instance, have all their meters calibrated to fit CHROMEL.

They have the same opinion of CHROMEL as does the Pittsburgh Plate Glass Co., for example, and the Geophysical Laboratory at Washington, who, after investigating all thermo-couple alloys, for the annealing of optical glass, adopted CHROMEL couples.

As stated by Mr. Cox of the Pittsburgh Plate Glass Co., "You can obtain on one order—Thermo-couple wire, insulators, lead wire and protection tubes—complete thermo-couple equipment. There is no weak link in the chain."

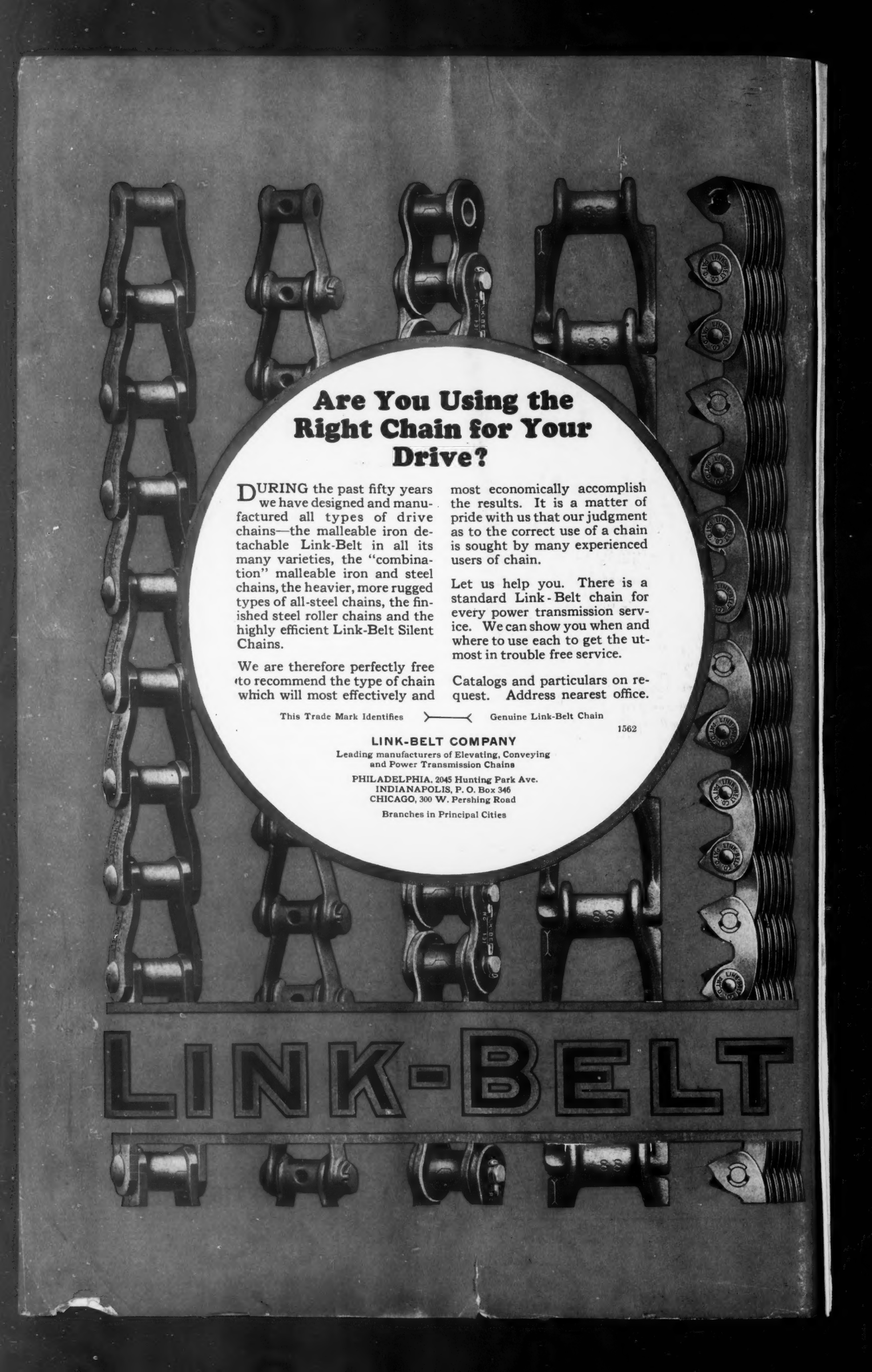
The foregoing are facts as related to us by authorities. They are unbiased. So, whatever pyrometer equipment you buy—play safe,—and specify CHROMEL couples.

HOSKINS MANUFACTURING CO.
4439 Lawton Ave. Detroit, Mich.

MAKE YOUR OWN

Thermo Couples

WITH Chromel WIRE


Are You Using the Right Chain for Your Drive?
DURING the past fifty years we have designed and manufactured all types of drive chains—the malleable iron detachable Link-Belt in all its many varieties, the "combination" malleable iron and steel chains, the heavier, more rugged types of all-steel chains, the finished steel roller chains and the highly efficient Link-Belt Silent Chains.
We are therefore perfectly free to recommend the type of chain which will most effectively and most economically accomplish the results. It is a matter of pride with us that our judgment as to the correct use of a chain is sought by many experienced users of chain.
Let us help you. There is a standard Link-Belt chain for every power transmission service. We can show you when and where to use each to get the utmost in trouble free service.
Catalogs and particulars on request. Address nearest office.
This Trade Mark Identifies Genuine Link-Belt Chain
1562
LINK-BELT COMPANY
Leading manufacturers of Elevating, Conveying and Power Transmission Chains
PHILADELPHIA, 2045 Hunting Park Ave.
INDIANAPOLIS, P. O. Box 346
CHICAGO, 300 W. Pershing Road
Branches in Principal Cities
LINK-BELT